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Beaded or Pearl Lightning Flashes.

By WILLIAM J. S. LOCKYER, M.A., Ph.D., F.R.A.S.

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It would be interesting to know whether, in the direction in which the photographs were taken, there were any electric lamps worked by an alternate current. If there were, then it is quite possible that the image of one of those might have fallen on the plate during exposure. Such an image allowed to trail would produce such a "beaded" appearance, owing to the intermittent nature of the light, as will be seen further on.

In a subsequent portion of this article it is shown that such artificial light sources were present.

The fact that the "beads" are not at an equal distance from each other is easily explainable since the movement of the camera was not uniform, as it was held in the hand.

A very strong argument against the reality of these flashes representing "beaded lightning" is the fact that in Figs. 4 and 5 the trails commence from the lower portion of the plate and retrace their path there. As the lower part of the picture is where the landscape would naturally appear, is it not there that an artificial light source would impress its image on the plate? Even the second so-called "beaded" flash in Fig. 4 comes into the picture from the left side and turns back again.

Such dotted streaks have since been secured on the photographic plate during a thunderstorm, and these

Fig. 6.—The Trail of a Naked Arc Lamp, fed by a continuous current, as recorded on a Camera moved by hand.

were distinctly the trails of electric lamps, because it was known that such lamps were in the field of view of the camera. Several instances of such markings can be seen by the reader if reference be made to a volume of *Nature* (vol. lxi., p. 343, 1900).

To satisfy my own curiosity, however, I have secured the trails of several light sources, originating from continuous and alternating currents, on a moving photographic plate.

In the first instance I carefully focussed my hand-camera on a naked arc lamp fed by a continuous current. While the arc was burning I pointed the camera at it, keeping it in movement the whole time. The result is seen in Fig. 6. The arc being, to all intents and purposes, a point of light, we have a thin streak recorded on the plate; in fact, a seismogram of the camera movement. It will be noted that the line is perfectly continuous throughout its whole length, but loops and knots occur where the direction of motion of the camera was greatly changed.

In order to secure trails of many

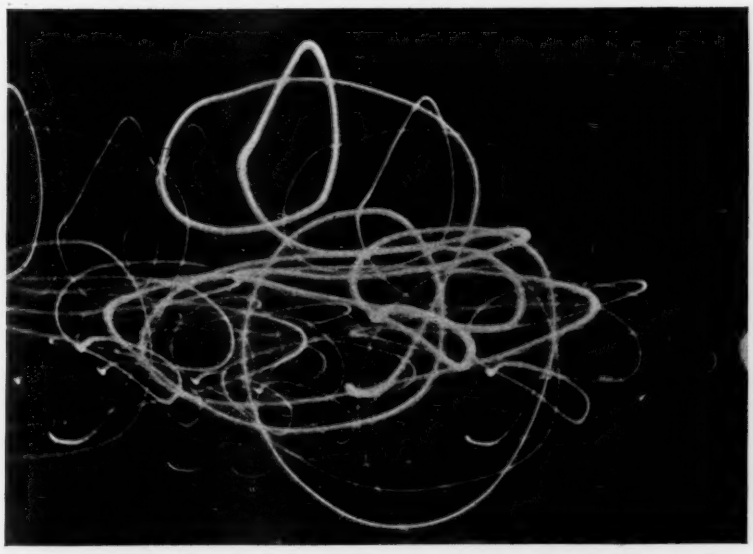

Fig. 7.—Trials of some Arc Lamps in front of Buckingham Palace (continuous current taken with a Moving Camera.

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alternating current arcs on one photographic plate I made a night journey by bicycle from Earl's Court to the Mall, where the lights are both brilliant and numerous. The arc lights, however, in front of Buckingham Palace, were found to be fed by a continuous current, so that the trails I photographed were continuous (see

Fig. 8.—Trail of an Arc Lamp (alternating current) taken with a moving Camera, near Walham Green.

Fig. 7) like those in Fig. 6, and not "dotted" as I expected. The large globes round the arcs made the trails of the near lamps rather broad, but by including in the photograph distant lamps as well, various breadths were recorded.

Another night journey in the direction of Walham Green gave me, however, the record I wanted, for there the lamps are on the alternating current system. One of several photographs I obtained is shown in Fig. 8. Unfortunately, I did not quite get my camera in focus, so that the "dotted" trails on the plate are not so sharp as they ought to have been. Nevertheless, the photograph indicates that such artificial light sources give us practically the same beaded appearance when recorded on a moving plate as that shown in Figs. 4 and 5, showing that in all probability the origin is similar in each case. I may add, further, that I purposely moved the camera in such a manner to reproduce if possible on some parts of the plate loops as shown in Fig. 4, and in this I was partly successful, as the reader may see from the photograph.

In the preparation of this article I have had occasion to look up and verify a great many references. I have, however, been fortunate enough to come across a short note in the *Meteorologische Zeitschrift* (vol. xx., p. 379, 1903) in which the above proposed explanation of "beaded" lightning has not only been suggested, but the writer, Herr V. Behn, had experimented on electric currents in the laboratory in a somewhat similar way to that which I adopted. This independent piece of work is, therefore, completely corroborated by the experiments I have made, and strengthens the argument for the suggested origin of the supposed "beaded" lightning flashes. Further, Herr Behn states in the note that he was able to find out that the alternating current system existed in Davos, where Van der Valk obtained his photographs, after the year 1894, so that the evidence for the electric lamps as the origin of the streaks is very overwhelming.

From the numerous and very similar accounts of the appearances of "beaded" flashes of lightning to which reference has been made, it does not seem to me that we must necessarily assume the occasional existence of such peculiar flashes. I think it quite possible that, in each case noted, the actual flash was really continuous in its whole length, but in the later stage of the discharge, that is, the "after-glow" stage, it appeared to be discontinuous.

The incandescence of the air caused by the initial discharge lasts for a much longer time than one at first is inclined to believe. That it is by no means momentary can be easily demonstrated by photographing lightning with a moving camera; in fact, the camera need not even be moving with any great velocity.

Such a photograph as is here referred to is shown in the accompanying illustration, Fig. 9, and is one of numerous very excellent photographs which have been secured by Dr. B. Walter, of Hamburg. It will be seen that after the flash had recorded its form on the photographic plate (left-hand side) the air in places remained sufficiently brilliant, or, in other words, the after-glow was bright enough, to allow an impression of the brighter parts to be clearly recorded in the form of

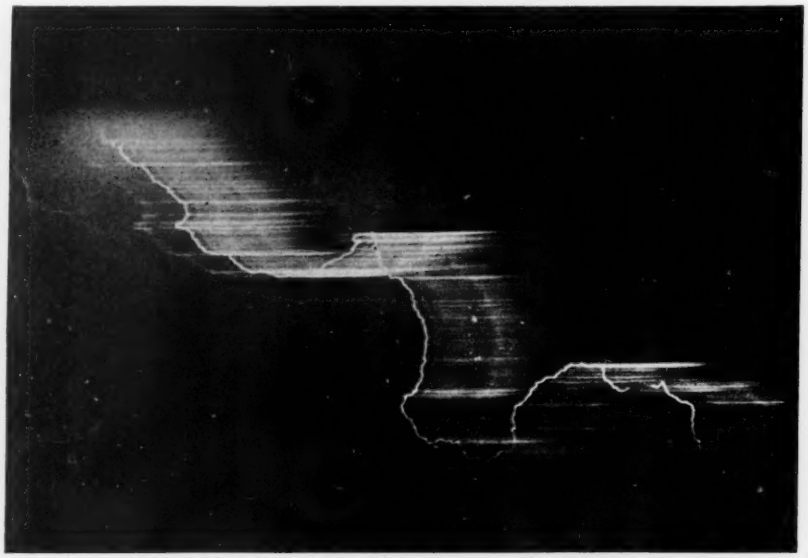

Fig. 9.—Photograph of a Flash of Lightning taken with a moving Camera by Dr. B. Walter, of Hamburg. This shows that at some points along the track of the discharge the after-glow is so brilliant that it affects the sensitive film after the main discharge has passed.

trails as the camera moved. It will be seen, further, that the stronger trails are nearly always at those points along the track of a flash where the path of the discharge changes its direction, and photographs have clearly demonstrated that the path of a lightning flash is never straight, but always wavy.

It is, therefore, quite possible that what has been noted by the observers has been these series of bright points, which constitute the after-glow, along the path where the original flash passed. The points are not necessarily equally distant from each other, but the whole series, as seen from afar, would appear very probably as a chain of bright points.

If one reads again some of the above extracts from this point of view, the observations seem very strongly to bear out this view. Thus Mr. Wood Smith says that one flash "remained visible, I should think, for half a second, gradually dying out."

Dr. Hapke even stated that "the flash which lasted somewhat longer than the other, *resolved* itself into small, single, red balls. . . ."

The use of the word "resolved" here evidently indicates that the "beaded" appearance became apparent after the actual discharge had ceased.

Again, Kapuscha stated that "the flash was furnished with about 10 to 12 yellow shining points, which, while the flash in question had already disappeared, were still visible half a second longer. . . ."

The observation made by Dr. Pockels seems to endorse entirely the view put forward above for he states:

"The after-glow of the lightning flash was not continuous along its path, but consisted of a series of distinct, separate points separated from each other by equal intervals, so that the appearance, in fact, was just comparable with a shining string of pearls."

From the above it will be clearly gathered that it was the "after-glow" and not the actual lightning discharge which exhibited this beaded appearance. Dr. Pockel's description is a very accurate account, which would apply probably to all cases of "beaded" lightning, and, being personally acquainted with the observer, I can vouch for his extreme carefulness and accuracy in making such a definite statement.

One is thus led to the conclusion that "beaded," "chapletted," "chain," or "pearl" lightning is not a distinct form of lightning discharge at all, but an after effect only.

It will further be found to be an extremely difficult subject to photograph. It will be necessary first to wait until the main discharge is over, and then to expose the plate on the after-glow, keeping the camera still the whole time. As the whole phenomenon lasts generally less than half a second, the difficulty of the procedure becomes apparent.

The only way I can suggest is to try and "snap-shot" the original lightning discharge itself, because the operator will, in nearly every case, make the exposure too late. He will, however, at any rate, have a chance of recording the after-glow should he be quick and lucky enough, and should the glow be sufficiently bright. The image would then show a series of bright points as so many observers have recorded them.

Bushmen Paintings.

THE Transvaal *Government Gazette* of April 20, announces the appointment of a Commission consisting of the following gentlemen: Dr. Kynaston (Geological Survey Department); Mr. T. N. Leslie (Vereeniging); Mr. J. P. Johnson, M.I.M.M. (Johannesburg); and Professor R. B. Young (Transvaal University College), "to report to the Government on the Bushmen paintings and stone etchings existing in the Transvaal, and as to what steps should be taken to preserve them from decay and mutilation."

The Examination of Handwriting.

By C. AINSWORTH MITCHELL, B.A. (Oxon.), F.I.C.

IT is remarkable how little use has been made of chemical or photographic methods in the examination of handwriting, especially in cases where the evidence of the expert has been inconclusive, and where, perhaps, the point in dispute might easily have been settled by the use of special reagents or of the camera.

Notwithstanding a general similarity in the composition of many commercial inks, the characters made with each on paper can usually be differentiated, and it is even possible sometimes to distinguish between writings done with the same ink but at different periods.

The most common type of modern inks consists in the main of an extract of galls or other source of tannin mixed with a solution of iron sulphate. When protected from oxidation this is a very pale fluid, which only darkens slowly on contact with the air, though eventually it forms a deep black tannate of iron. In the older type of inks in use at the beginning of the last century this darkening process was allowed to take place in the ink itself, which would then contain an insoluble powder in suspension, and would give black characters at once on the surface of the paper. But such inks were apt to clog the pen, especially when the darkening process of oxidation had proceeded too far, and, lacking penetrating power, could sometimes be washed off the paper; whereas in the case of their successors the oxidation takes place within the fibres of the paper, leaving an insoluble pigment which is difficult to remove.

The writing done with a fresh, unoxidised iron-gall ink is extremely pale at first, and it is to obviate this drawback that what is termed a "provisional" colouring matter is added to inks, so as to make the words sufficiently dark before oxidation has taken place. Manufacturers employ various substances as the provisional colour, and this affords a valuable means of distinguishing one iron-gall ink from another. Indigo is in common use for the purpose, and is the source of the blue in many of the "blue-black" inks. Aniline dyes are also frequently employed, whilst logwood extract is found in some of the "purple-black" and "violet-black" iron-gall inks, and vanadium salts in other unoxidised inks.

There are also numerous inks in which logwood extract mixed with copper salts, alum, or chromates is the chief constituent, and others which are mainly solutions of aniline dyestuffs. When the dried writing done with these different inks is tested with various reagents, pronounced differences will usually be observed. For instance, words written with a typical blue-black ink containing indigo were nearly bleached and smudged when treated with a 10 per cent. solution of oxalic acid, and completely bleached by 10 per cent. hydrochloric acid and by bromine water. An aniline black ink writing was darkened by hydrochloric acid, not affected by oxalic acid, but nearly bleached, with slight smudging, by bromine water. Other inks examined by the writer and found to contain vanadium, alum, logwood, chromates, &c., each gave different results when tested with these reagents. In short, it is extremely unlikely that two inks should be so nearly alike as to give writing which should be equally permanent or change colour in the same way on contact with reagents.

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The three reagents mentioned above are among the most useful, but many others may be employed. Thus an acidified 1 per cent. solution of potassium ferrocyanide gives a deep blue colour with an iron-gall ink, and a red colour with a chrome logwood ink, whilst it leaves an aniline ink unchanged. Dilute solutions of gold chloride, of bleaching powder, and of caustic soda are also valuable reagents. They are best applied to the writing by means of a camel's hair brush or a feather, a note being taken of the changes that occur at the juncture of the ink and the paper. As a rule it will easily be seen whether the whole of the characters was written with the same ink.

Erasures may be detected by treating the surface of the paper with distilled water and noting whether the absorption is greater in one part than another owing to the sizing having been removed at the same time as the writing. Skilful forgers have been known to replace the sizing by rosin and glue, and this may be detected by treating the paper firstly with hot water and then with alcohol, and again examining the surface.

Traces of a prior writing may also in some cases be made apparent by the use of an intensifying reagent, such as potassium ferrocyanide. Former writing has been known to appear, even after remaining in contact with the reagent for 24 hours before any result has been obtained.

It was stated some years ago by Dr. Jeserich that inks when dried on paper, though apparently black to the eye, were really of different shades, some being red, others blue, &c., and that these differences were clearly shown in a photograph on an ordinary plate, and still more so on an isochromatic plate. This method, which was subsequently recommended by Dr. Minovici, has not proved successful in the writer's hands.

Specimens of writing done with different commercial inks could be seen to vary in intensity to the naked eye, but this difference was no more marked in a photograph taken on an ordinary plate or by means of a Cadett spectrum plate and "absolutus" screen.

On the other hand, the method of photographic enlargement has proved of the greatest assistance in the detection of forgery, especially in cases where it was not possible to examine the document by chemical methods.

Any mechanical erasure on the surface of the paper, which may hardly be shown by the greater transparency of the spot, is made much more apparent when photographed by transmitted light, the place then appearing as a blot. The slight spreading of the ink over the fibres of the paper from which the sizing had been partially removed might be all but invisible to the eye, and yet be plainly revealed in the roughened edges of the strokes in an enlarged photograph.

Slight differences in the forms of letters or figures become enormous in the enlargement, and the addition of a "y" to "eight," for instance, or the change of "o" into "9" is readily detected, and as readily demonstrated before a jury, by the photographic method.

Apart from the detection of forgery, chemical methods have proved of great value in the examination of old or faded documents. In the case of *palimpsests*, for instance, those ancient parchments which were used a second time after being scoured to obliterate the writing of an earlier period, striking results have been obtained by the use of intensifying reagents, for traces of iron in the letters written in the first ink have been left within the fibres of the skin, and this iron can be converted into dark compounds so as to render the writing once more visible. In this way many valuable manuscripts have been deciphered beneath a layer of worthless monkish writing of three or four centuries later.

The earliest and best known method is to sponge the parchment or paper with a dilute extract of galls, and this method is described in a book on inks by Canneparius, of Venice, an edition of which was published in 1660 in London.

Sir Charles Blagden was the first to suggest, in 1787, the more reliable method of treating the writing with a dilute solution of hydrochloric acid and potassium ferrocyanide so as to form a dark blue compound with the residual iron in the fibres.

A modern and less drastic means is to suspend the document in a glass-covered box over a dish containing ammonium sulphide, the vapours from which convert the iron of the writing into a dark sulphide.

These and similar methods based on the conversion of the residual iron in the writing into dark-coloured compounds afford an easy way of distinguishing between iron-gall inks and carbon inks, composed of lamp black and glue, which were in use centuries earlier.

Thus Blagden was able to show that the writing on certain vellum inks of the 9th century had been done with an iron ink.

It is difficult to determine at what period the transition from carbon inks to iron-gall inks took place, but it probably coincided with the adoption of parchment as a writing material in place of papyrus, since the carbon ink would be difficult to apply and easily removed from the surface of the skin.

Sir Humphrey Davy, who examined fragments of papyri from the ruins of Herculaneum, was unable to detect any traces of iron oxide "in the manuscripts or on the animal (*sic*) charcoal surrounding them."

The earliest reference the writer has been able to find with regard to the use of iron inks is in an encyclopœdia of Christian arts written in the eleventh century by the monk Theophilus. A description is there given of a method of making writing ink from a decoction of thorn wood mixed with green vitriol.

But the experiments mentioned above prove that iron tannin inks were in common use at least three centuries earlier than this, and it is evident that even then the right proportion of galls (or other source of tannin) had been found, for the writing in many early MSS., such as the Lindisfarne Gospels of the seventh century, is still perfectly black, which shows that there was neither excess nor deficiency in the amount of iron.

SOME new facts have lately been added to the botanic knowledge of the germinating powers of long-preserved seeds. M. Paul Becquerel has communicated the results of his experiments with 550 species and thirty families of seeds that had been preserved in the museum of the Académie des Sciences. These seeds had been perserved for periods varying from twenty-five to one hundred and twenty-five years. A good many seeds which had the reputation of being good for several centuries did not germinate, and twenty-three only out of his 550 species lived. Poppy, tobacco, euphorbia, foxglove failed, and the three species of seeds over forty-five years old which germinated were *Acacia bicapsularis*, *Cytisus biflorus*, and *Leucœna leucocephala*. These were all seeds with thick integuments and well-protected, therefore, against the air.

Ancient British Footprints.

By R. LYDEKKER.

THE recent gift to the British Museum (Natural History) of a slab of Keuper sandstone from the quarries at Storeton, near Birkenhead, Cheshire, showing well-preserved casts of footprints of the type commonly known as *Chirotherium* or *Chirosaurus*, may serve to awaken renewed interest in the subject of fossil footprints in general, more especially as a paper relating to those from Cheshire appeared in the British Association Report for 1903. Before going further, reference should, however, be made to the generosity of the proprietors of the Storeton quarries in presenting the new slab, together with a second but smaller one, to the national collection.

Although they were doubtless known at a much earlier period alike to British and Continental quarrymen, the earliest record of the existence of footprints of the present type in the Keuper, or upper Triassic, sandstone appear to date from 1824, in which year specimens from Tarporley in Cheshire and from Corncockle Muir in Dumfriesshire were discovered. The Scotch specimens were noticed four years later, without, however, receiving a definite scientific name; but those from Tarporley were not described till 1838, when, together with smaller ones from Storeton, they formed the subject of a paper communicated by Sir Philip Grey Egerton to the Geological Society of London.* Meanwhile the German naturalist Kaup, when describing in 1835 footprints of similar type from a lower division (Bunter) of the Trias of Hessberg, on the borders of the Thuringerwald, had proposed for the unknown animal by which they were made the name of *Chirotherium barthi*, with the alternative title of *Chirosaurus barthi*, should it turn out to be a reptile instead of, as was then supposed probable, a mammal.

With this description before him, Sir P. Egerton came to the conclusion that the Tarporley footprints, which measure about 15 inches in length, indicated a much larger animal than the one which made the Hessberg tracks, and accordingly suggested that it should be called *Chirotherium herculis*. The smaller Storeton prints, which are usually about eight and a half inches long, still remained without a name; and it was not till the year 1863 that the name *Chirotherium stortonense* was given to the creature by which they were made†

Other localities in Cheshire where footprints of similar type have been obtained are Runcorn, Weston, and Lymm. At Storeton the quarries are worked in the lower Keuper sandstone. The footprint beds are confined to a layer of three or four feet in thickness, and are usually three in number. In many cases, at any rate, the prints are in thin seams of white clay, and when first exposed are often almost invisible, requiring a few years of exposure to the weather before their distinctive features are properly revealed. At Runcorn the sandstone is somewhat coarser, although on the same horizon; but at Tarporley the tracks occur in a rather higher zone of the Keuper division of the Trias.

As is well shown in the photograph of the new slab, in which two lines of tracks crossing one another almost at right angles are preserved, the footprints of

Slab of Storeton Sandstone showing impressions of the footprints of animals, recently presented to the British Museum by the Proprietors of the Storeton Quarries.

Chirotherium (or *Chirosaurus*) comprise impressions of a larger and a smaller pair of feet, evidently representing the hind and fore feet of one and the same animal. In the track comprising five of the larger prints in the new slab, one of the smaller prints is seen immediately in advance of the second from the left of the larger ones, and another, but less well preserved, small print between the first and second of the large prints. In both large and small prints five toes are plainly seen, of which the middle one, in the prints of the hind-feet at any rate, is distinctly the longest. It was from this five-toed character that the problematical creature by which the prints were made on the sands of the Triassic epoch was named *Chirotherium*—the "hand animal."

Prints exhibiting certain variation in size or form, or in both together, from those of *Chirotherium stortonense* have been obtained at Storeton and Lymm. One type from Lymm has, for instance, shorter toes; while in *C. minus* from Storeton not only are the toes relatively shorter, but the whole foot is smaller. In yet another

* *Proc. Geol. Soc.*, vol. iii., pp. 12 and 14.

† G. H. Morton, *Proc. Liverpool Geol. Soc.* 1863, p. 17.

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type the impression of only four toes is shown, that of the outermost one being lacking. It is not improbable, however, that this difference may be due merely to the creature not having brought the outer side of the foot on to the ground with sufficient weight to have made an impression. On some slabs there are indications of what may be a trail left by a tail; while one block of sandstone shows the impress of scales on the prints.

In some of the older books on geology and palæontology will be found a most marvellous restoration of the *Chirotherium*, in which the creature was modelled somewhat on the lines of an enormous frog, with one of the joints in the hind-limbs projecting far above the level of the back. Such a restoration was, however, soon shown to be a physical impossibility, and it gradually came to be recognised that the footprints were probably made by some of the labyrinthodonts, or primeval salamanders, which flourished during the period of the Permian and Trias, when the New Red Sandstone of Cheshire was in course of deposition. It has not yet, however, been found possible to definitely identify the footprints of either *Chirotherium stortonense* or *C. herculis* with any named species of labyrinthodont; neither is there decisive evidence to show that the discrepancy in the matter of size between the hind and fore feet of any labyrinthodont is so great as in the case of the *Chirotherium* footprints. Still, as labyrinthodonts were the dominant large land vertebrates of the Permo-Trias, it is difficult to attribute the footprints to the agency of any other creatures.

In the left-hand corner of the new slab are seen certain tracks much smaller than those of *Chirotherium*, and also differing in type, but the nature of the animal by which they were made cannot at present be even guessed. In addition to these, the whole surface of the slab is scored over by a vast number of very much smaller footprints, which may confidently be assigned to the relatively small Triassic reptile *Rhynchosaurus articeps*, one of the forerunners of the tuatera (*Sphenodon punctatus*), the sole survivor of the once abundant group of beaked lizards, or Rhynchocephalia.

More interesting glimpses into the history of the past than those afforded by the Storeton footprints it would be difficult to find, the interest being, perhaps, intensified by the uncertainty still prevailing as to the exact nature of the creature by which those of the *Chirotherium* type were made.

Observation of Meteors.

By W. F. DENNING, F.R.A.S., &c.

WITH July the meteoric season may be said to commence and to offer advantages not common to preceding months. But it is not until the middle of July that meteors are usually to be observed with tolerable frequency. The strong twilight is apt to overpower many of them until that period, even if they should visit our part of space more plentifully than usual.

In the third week of the month two distinct and definite showers begin to actively manifest themselves. They are the δ Aquarids and early Perseids of the rich and durable shower which has made August a notable month for its conspicuously abundant shooting stars. And these are both highly interesting systems to the regular meteoric observer, though that of Perseus is incomparably the most important in many of its bearings. It has instructive historical associations, a cometary derivation, a fairly rich annual maximum, a moving radiant and a duration of exceptional length for a periodical display.

The Aquarids apparently form a fixed radiant point from about July 23 to August 23, but more observations are desirable to support this fact.

Without making special efforts in regard to any particular shower the observer may best direct his attention to recording the meteors which appear, and subsequently deriving their radiant points. In watching for meteors from any special radiant there is a probability that objects nearly conformable to it, but really belonging to other showers, may be wrongly attributed, and erroneous conclusions drawn as a natural consequence. The observer, therefore, is advised to engage in charting the paths presented, with a view to ascertain the radiant points in a perfectly independent manner. The strongest and best showers will be sure to reveal themselves. For displays like the Perseids the radiant should be obtained separately from the flights noted on single nights of observation. This also applies to the Aquarids near their maximum on the last few days of July. But for the minor showers generally this is scarcely practicable, owing to their extreme feebleness. In such cases we must combine the materials gathered on several nights in order to have a sufficiency on which to base reliable deductions.

Though the shower of Perseids has been assiduously observed during a long period, and particularly during the last half a century, there remain a number of important features either to be detected or substantiated. The radiant points of the minor showers have never, perhaps, been adequately studied, nor has the main display of Perseids been investigated as regards their actual duration, its strength in different years, and the remarkable displacement of its radiant point on successive nights. This year no moonlight will interfere with the observations near the time of maximum, and it is to be hoped that the weather will be very clear so that a harvest of fresh data may be gathered and some new facts deduced in relation to this Perseid shower, which certainly forms one of the most attractive astronomical events of the year.

Photography: Pure and Applied.

By CHAPMAN JONES, F.I.C., F.C.S., &c.

Direct Colour Printing.

I have recently been making a few experiments with the colour printing-out paper made commercially by Dr. J. H. Smith and Co., of Zurich. By simple exposure under a coloured transparent positive it gives a positive print in very much the same colours as the original. It is obvious that for this result the paper should be black, and the action of light should be to give whiteness but with the addition of colour discrimination. The results obtained with this paper depend upon the same fundamental principles as the innumerable three-colour processes. Here, however, the three colours are present to begin with, and light bleaches them. As light is effective only when it is absorbed, if the incident light is coloured, so far as its colour matches the tint of either of the three dyes it is reflected by that particular dye, and therefore does not affect it while it bleaches the other two dyes by which it is absorbed. Red light, for example, is reflected by the red dye, and therefore does not interfere with it, but being absorbed by the yellow and blue dyes it bleaches them—and so the red light produces a red colour in the print.

The paper as supplied is a dark slate colour, and this represents the black. The dyes are held in a collodion film and are present in just sufficient quantity to appear nearly black. By exposure under a coloured subject to direct sunshine for about half an hour, the colours and detail of the original are reproduced in a surprising manner. Red, blue, and yellow are reproduced with great brilliancy, green, violet, and purple show well, and a grey tends generally, so far as I have tried it, to come out with a rather bluish tint. The dyes must, of course, be fugitive in light, but they are apparently made more fugitive by the presence of oil of aniseed, or something of the kind, which imparts a strong odour to the paper. After the exposure, the print is soaked for an hour or so in two baths of benzene or some similar solvent, which presumably washes out the sensitising oil and so renders the colour less fugitive. By exposure to sunshine for a few hours, the black part of a finished print turns blue, and then violet. The difficulties met with in elaborating such a process must be very great, and the paper now put upon the market must be regarded as remarkably successful. In working with it, the principles upon which its action is based must be borne in mind, and as it depends upon the destruction of its colour by light, the resulting prints must be taken due care of if they are to last.

Shading the Lens. The question of the advantages gained by shading the lens has recently been brought to the front. There can be little doubt that it is desirable to keep useless light from entering the camera, particularly when very rapid plates are used. Modern lenses generally include a very wide angle, that is, they would cover much larger plates than the sizes that they are most often used for. A half-plate lens, for example, may give an image extensive enough to cover a 10 by 8 or even a 12 by 10 plate, and when used on a half-plate camera the light that surrounds the plate falls upon the inside of the camera and causes this to become luminous. There is thus a considerable quantity of general or non-image-forming light that tends to fog the plate. The advantages and disadvantages of allowing a certain amount of general light to fall upon the sensitive surface, in addition to the light that forms the image, were discussed a generation or more ago. The plates used then were very slow, and doubtless, in some cases it was possible to safely reduce their "inertia" by such means. But circumstances at the present time are very different in many ways. While our plates are far more sensitive, the modern type of lens includes a much wider angle than the lenses generally used before the anastigmat era, and as the optician must not restrict the scope of his lens, hoods have almost disappeared. Thus, while extraneous light is less permissible, we have more of it and less protection from it.

Lens hoods, so far as they form a part of the mount, must be circular, or the field of the lens would be restricted, and therefore the opticians' "hood" can never be effective. What is really wanted is a diaphragm or frame, fixed on an extension in front of the lens, with a rectangular opening in it of exactly the same proportions as the plate. If different sizes of plates are to be used, the opening should be adjustable, and each edge should be in such a position that it is just outside the field of vision when the eye is brought to the extreme edge of the plate on the opposite side and one looks through the lens. Such an apparatus must apparently be cumbrous if adapted for a field camera of half-plate or larger size, but a hand-camera, in which the box projects beyond the lens, can easily be arranged so that the opening in the box forms the required diaphragm. I have for many years used a camera so constructed, but with the opening extended a little as necessary in two directions, to allow of the use of the rising front in its two directions. If a diaphragm with the necessary extension is too awkward for large cameras out of doors, a sky-shade or flap is the best substitute, as this keeps off the light from the upper, which is the brightest, side. A sky-shade should extend well forward over the lens, and have a straight edge always parallel to the camera front, and be provided with a vertical adjustment. It should be lowered as much as possible without being at all visible when looking through the lens from the lowest edge of the focussing screen.

Shutter Exposures. At about this time of year there will be an enormous number of exposures made by means of shutters, and probably not one in a thousand will do otherwise than suppose that the shutter used will give an exposure of the duration marked on it, or at least of the same duration as it has given in previous years. There is probably no piece of machinery that is so faithfully (or blindly) trusted as a photographic shutter. We continually check the performance of clocks and watches which are, as a rule, better made and less exposed to adverse influences. No one would maintain that it was a certain time of day merely because his timepiece pointed to that hour, but it is the rule to state, without qualification, that a certain exposure has been given for no other reason than that the shutter index was set to a certain mark. The photographer cannot be constantly checking his shutter, as he can his watch, by comparison with others, but he might bear in mind that all machinery is liable to change, and he might every day see that the longer exposures, the second, and the half and quarter of a second, are approximately what they should be. With a little practice these exposures can be judged of by mere inspection. Then the tenth of a second should be perceptibly shorter than the quarter, and the twentieth shorter than the tenth. But how much shorter they are can hardly be guessed. For still shorter exposures, the unaided eye is of very little use. A few minutes' examination in this way will give at least a rough idea as to whether the shutter is working as it ought.

Received. The "Swincam" tripod stand is now made in a cheaper model (£1 11s. 6d.), by Mr. Butler, of Southport. It has the same general characteristics and the same unique mobility of head as the original pattern.

"Pushaxe," a very concentrated one solution developer, suitable for negatives, lantern plates, bromide paper, and gas-light paper.

AMONG a number of articles on biological subjects, in the April number of the *Museum Gazette*, perhaps the most generally interesting is one on those curious, bushy growths in trees commonly known as "witches' brooms." They appear to be due to some early disturbance to the regular growth of a shoot-producing bud, which causes the production of a number of abnormal shoots, each of which subsequently branches on its own account. They are most common in birches and beeches, and are not infrequent in elms. Parasites, either animal or vegetable, are generally the inducing cause; but in some cases the growths may apparently be the result of mechanical injury. Hollow trees and their causes form the subject of another article.

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Stem-Roots of the Elm.

By FELIX OSWALD, D.Sc.

ONE of the most familiar aspects of large tropical estuaries is the broad fringing belt of mangrove-swamps, which render it so difficult to say where the water ends and the land begins. The mangrove trees are firmly anchored in the treacherous, miasmic mud by means of numerous stilt-like roots which raise the stems out of reach of the tidal waters. These roots do not grow exclusively from the lower end of the stem as in the majority of plants, but proceed laterally at different heights, and act like flying buttresses to retain the tree in an upright position and to prevent it from toppling over. As the roots increase in age, their internal structure approximates more and more to that of the stem, until it is indistinguishable from it, and they serve not merely as props, but continually lengthen so as to raise the stem higher above the mud. Roots of this nature, arising adventitiously, that is to say, in unexpected places, are not uncommon in warm and moist climates; the columnar roots of the banyan-tree and

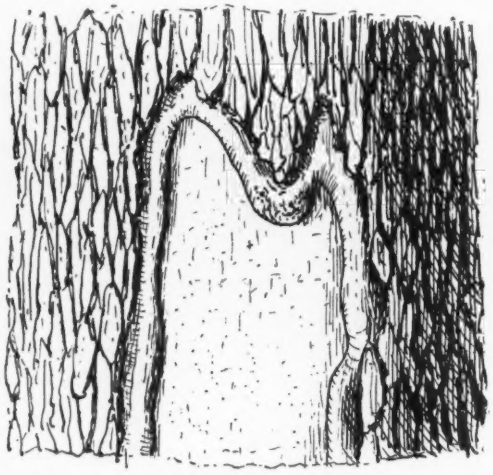

Fig. 1.—Formation of callus over an irregular wound of an elm tree in Hyde Park.

the stilt-roots of the screw pine are as well known as those of the mangrove, and in the Clusiaceæ or balsam trees the stilt-roots become actually thicker than the stem they support. In the screw pine of the New Guinea mountains such roots grow downwards, even from a height of 60 feet.

In our temperate climate adventitious roots are neither frequent nor conspicuous. The tiny stem-roots of the ivy, which enable it to climb, have the appearance and the function of suckers rather than roots. In neglected vineries the appearance of roots proceeding from the stem is a sure sign that the action of the true roots is defective and insufficient for the needs of the plant.

Large woody roots may, however, frequently be observed on the trunks of many old elms in the London parks, but only on diseased or injured trees. In this case the occurrence has clearly a pathological origin. The roots usually arise at a height of ten feet or more above the ground on elms, which have, in the first place, been attacked by wood-eating beetles, such as *Scolytus destructor*. These destructive insects run their burrows in the soft bast and the cambium; that is to say, in the actively-growing layer of the tree between the bast and the wood. The social habits of the beetle render the damage much greater than if it were solitary, for the female lays its eggs on either side of its burrow, so that as the young grubs eat their way, they form galleries radiating away from the central burrow and lying in the same plane. When several of these compound burrows lie near together, a considerable portion of the bark becomes permanently separated from the wood of the tree-trunk, which is traversed by the radiating patterns of the *Scolytus*.

When the attacks of the beetles have ceased, the tree attempts to close up the exposed wood by means of a callus of actively-dividing tissue proceeding from the still uninjured cambium surrounding the bare patch.

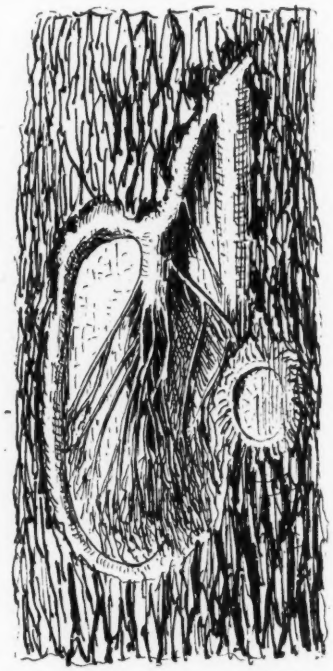

Fig. 2—Stem-roots which have formed at a height of ten feet from the ground. Elm in St. James's Park.

Under ordinary circumstances, when a circular scar is left by a branch that has been cut off, the ring of healing tissue grows uniformly inwards, and finally meets in the centre of the wound, closing it up completely. In elms which have been extensively injured by these destructive boring beetles, the wound is in itself irregular, and more often oblong than circular; there is a tendency in these cases for the callus to form a slight tongue projecting downwards from the upper part of the scar (Fig. 1). Here the sap becomes congested, so to speak, owing to the obstruction of this *cul de sac* to the free downward passage of the nutritive juices which have been elaborated in the leaves by the action of light upon chlorophyll. If, now, the callus becomes exposed to the air by the loose bark being torn off by high winds or other agencies, the downwardly projecting lobe does not give rise to any special modification, but merely helps to close up the wound. If, on the other hand, the loose bark remains on the tree, this tongue of the callus seems to be stimulated to form roots both by the darkness and by the presence of moist *débris*, excreta, and sawdust ejected by the wood-boring insects

from their burrows. These roots branch profusely and often form a thick mat of fibrous rootlets; the main root near its point of origin may attain a diameter of three or four inches (Figs. 2 and 3). The accompanying sketches were made by the writer from elm trees in St. James's Park and in Hyde Park. In one instance the figure shows that the roots succeeded in reaching the ground (Fig. 3), but in the majority of cases they are situated at too great a height ever to be able to exercise the functions of roots.

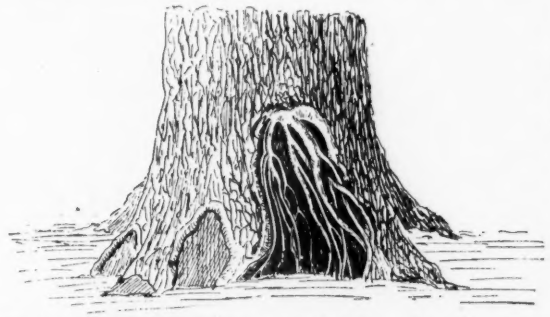

Fig. 3—Stem-roots which have succeeded in reaching the ground. Elm in St. James's Park.

This effort on the part of the stem under abnormal conditions to send down roots to the ground has been recorded in several other trees, for the purpose both of anchoring the tree and of taking the place of ordinary roots. In the case of yews or spruce firs blown down by the wind, the prostrate trunks have been known to emit roots from their under surface to take the place of the roots which have been destroyed. Adventitious roots have also been observed in the case of the ash, elder, lime, and poplar; when an injury has happened to the crown of the tree and the trunk has become hollow, roots have been seen to make their way down inside the rotten shell of the trunk in an attempt to reach the ground.

Is There a Central Sun?

By F. W. HENKEL, B.A., F.R.A.S.

THREE HUNDRED AND FIFTY YEARS ago it was generally believed that our earth was the centre of the visible universe. It is true that Pythagoras, more than two thousand years before, had taught that the earth was in motion around the "central fire," but few either of his contemporaries or of later astronomers accepted his views. In 1543 appeared the great work of Copernicus, "De Revolutionibus Orbium Cælestium," in which the author showed how much more probable it is to suppose that the earth rotates on its axis in twenty-four hours than that the immensely distant stars should move round it in this time. He also shows how simply and satisfactorily the earth's motion around the sun accounts for all the complicated apparent motions of the planets, as seen from our standpoint. By degrees his views gained ground, the discoveries of Galileo and Kepler immensely strengthening the arguments in favour of this system; whilst Newton's enunciation of the law of universal gravity supplied the dynamical reasons for such motion. Thus the earth, no longer regarded at rest, was seen to be one, and by no means the largest, of a number of bodies all revolving round the sun (as their centre of force). The sun thus became, in men's eyes, the centre, and no longer the earth. Though even yet we are not quite certain as to his exact distance from us, yet enough was known on this point to show that his bulk was more than a million times that of the earth, and this, of itself, would render it more probable that the smaller body should move round the larger than that the larger one should circulate about the smaller. However, it was not a century from Newton's time when the sun itself, at first supposed at rest at the centre of our system, was shown to be really in motion, carrying all the planets (including our own earth) along with it. The great Sir W. Herschel, in his investigations of the proper motions of the stars, found that stars in one part of the sky showed a tendency to separate apart from one another, whilst in the opposite part they seemed closing in towards one another. This general tendency he supposed to be a consequence of the sun's (and earth's) own motion in the opposite direction. Just as, in the well-known illustration; a man walking in a forest would find the trees in front of him apparently separating apart, and those behind him coming together, so, too, the sun's motion would cause the stars towards which our system is approaching to appear to separate more widely and those from which it is receding to close up. Herschel's conclusions were confirmed by later observers, and their investigations have shown that the sun is moving towards a point in the constellation of Hercules, in our northern sky, which point is known as the "apex" of the sun's way. The speed of this movement is by no means certainly known, since we know so little as to the real distances of the stars from our solar system, but has been estimated by Ludwig Struve as about sixteen miles per second.

When it was seen that the earth was in motion in an orbit whose diameter is about 186 millions of miles, it was thought that so vast a change of position must cause a considerable displacement in their relative positions of the stars beyond, just as when we are ourselves in a train the motion of the latter causes outside objects to seem moving in the opposite direction, the nearer objects of the landscape being more displaced than those further off. Yet, until 1830, no such changes were certainly observed, and, indeed, the apparent absence of "parallax," as this displacement is called, led some to reject the theory of the earth's motion altogether. However, in a few cases such determinations have been actually made, but the measures are, perhaps, the most difficult in the whole of astronomical work. The nearest of all the stars, as far as is yet known, is so far off, that light, notwithstanding that its velocity is more than 186,000 miles per second, takes over four years to reach us from it. This star is the brightest one in the constellation of the Centaur, and is not visible in these latitudes, being too far south of the equator. So distant is it from us, that the whole displacement from its mean position due to the earth's annual motion is only three-quarters of a second of arc (60 seconds make a minute, there are 60 minutes to a degree, and 360 degrees to the whole circumference), or the angle subtended by a halfpenny at a distance of four miles from the eye!

No other star is even half so near as this. Sirius, the brightest known star, is nearly three times as far off as Alpha Centauri, and so, if the brightness of his surface is about equal to that of the sun (as seems not improbable), he must be some hundred times greater in size. 61 Cygni, a star of the 6th magnitude, or one just visible to the unaided eye, is at nearly the same distance as Sirius from us, and is probably smaller than our sun. On the other hand, the bright stars Alde-

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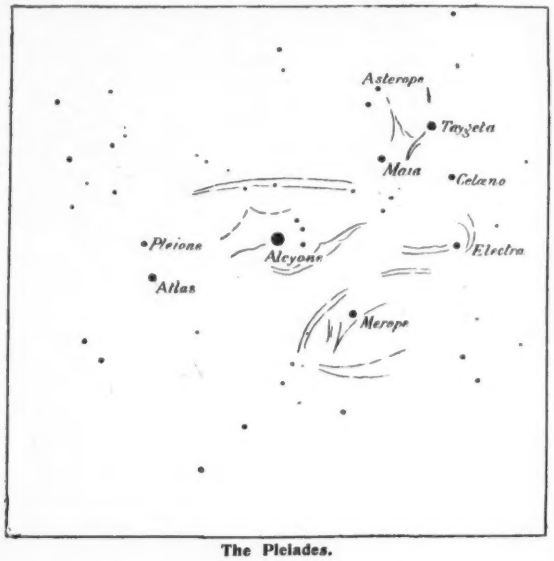
baran, Vega, and Arcturus are almost certainly much farther off than Sirius, whilst Canopus, the brightest star in the heavens next to Sirius, is so immensurably remote from us that it must surpass our sun as much as the latter exceeds his planets in size, and may truly be called a giant sun. It was at first not unnaturally supposed that the brighter stars were the nearest to us, but although Sirius and α Centauri, two of the brightest, are *comparatively* near to us, yet Canopus and Arcturus are much more remote than 61 Cygni, which is only a sixth magnitude star. A more certain indication of nearness is largeness of "proper motion,"* *i.e.*, those stars which change their places with regard to their neighbours with comparative rapidity. So far distant are even the nearest stars that in two thousand years Arcturus has not moved more than one degree, and Sirius only about half as much. A seventh magnitude star, one invisible to the unaided eye, known as 1830 Groombridge, from the astronomer who catalogued its position, has a movement of seven seconds of arc per annum, the most rapid as yet detected, but even this



The Pleiades.

requires nearly 300 years to move over a space equal to the apparent diameter of the sun or moon. Its distance is not very well ascertained, but it is almost certainly at least three times as far off as α Centauri, our nearest known neighbour. This star is sometimes known as the "runaway star," since its velocity cannot be less than 100 miles a second, and may be much greater if its distance be underestimated. Many of the stars have been found to possess proper motions displacing them gradually in their relative positions, but the most remarkable thing of all is to find that in many cases neighbouring stars have proper motions nearly the same in direction and amount. This, of course, is partly due to the sun's motion in space causing this apparent agreement, but allowing for this, there is no doubt that very many are physically connected, though they must be enormously distant from one another.

Thus, five of the seven stars forming the "Plough" are moving together as a body, and many of the Pleiades have a common motion. Though our knowledge of the sun's motion through space is too recent for us to perceive any deviation from a straight line, or, indeed, anything beyond the mere fact of this motion, yet there is little doubt but that the path must really be a curved one, and it has been supposed that our sun with other stars is revolving round some great central body.

From the community of motion of many of the Pleiades it was supposed by Mädler that Alcyone, the brightest star in that cluster, is the central sun round which the others, including our own sun, also revolve. Although, as Sir J. Herschel says, it is scarcely probable that any *general* circulation can take place in this position, lying so far out of the plane of the "Galactic Circle" (Milky Way), and our knowledge is by no means sufficient to decide such a point, yet there is no reason for doubting that this star may be at the centre of the motion of many of the neighbouring stars, and thus *a* central sun, though possibly not *our* central sun. In regard to the fact that neither proper motion nor parallax have been as yet detected in the case of Canopus, whose brightness is next to that of Sirius, if we suppose the intrinsic brightness of its surface comparable with that of our sun, its real size must be many thousand times greater, so that our sun must be in comparison with Canopus relatively at least as small as the planets are in comparison with it. Thus this star, invisible in our latitudes, may (in all probability) be the centre of a system whose members are at least as large as our own sun, if not larger, so that here we seem to have indications of the existence of bodies of a mighty scale of magnitude. There is a general unanimity of motion of several hundred stars in the Pleiades group, and if, with the late Miss Agnes Clerke, we take the probable parallax of Alcyone to be $0''.017$, in that case this star must be 170 times as bright as our own sun, Electra and Maia being 83 and 70 times respectively as bright as our own sun. A circle described round Alcyone as a centre with an angular radius of $48'$, including the principal stars in the Pleiades group, makes the exterior bodies at about $\frac{1}{170}$ ("three light years"†) the distance of Alcyone from our system, from the central body. The group is surrounded by large numbers of widely extended nebulæ, most of which were first discovered by the camera before they were perceived by the eye. Most of the members of this family have similar spectra, so that there seems no reason to doubt the very close connection of these bodies with one another, whilst the central position and predominance of Alcyone renders it highly probable that this star is the central sun of this system.

This, of course, in no way shows that our own sun also revolves round the same centre.

In a recent paper on the "Systematic Motion of the Stars," by Mr. Eddington (the new chief assistant at Greenwich), from the re-reduction and comparison of the earlier star catalogues of Groombridge and Carrington with later work at Greenwich, the author arrives at the following results:—The proper motions strongly support Kapteyn's hypothesis that the whole of the stars may be roughly separated into two "drifts" or groups. One drift is moving relatively to the sun, with a speed about three times that of the other. So far as has been examined, the numbers and magnitudes of the stars belonging to each of the two drifts are about the same, and they seem distributed in fairly equal proportions throughout the sky.

* Proper motion is that which remains after allowing for the apparent changes due to precession, nutation, and aberration.

† "A light year" is the distance travelled by light in a year in free space. Light moving with a velocity of 186,000 miles per second, this works out at about seven billions of miles (7×10^{12} miles.)

Longitudinal Stability.

A TERM that has been greatly in use of late in explanation of the movements of flying machines has been "longitudinal stability." Dr. G. H. Bryan, F.R.S., whose contributions on mathematical subjects will be familiar to readers of "KNOWLEDGE," and whose mathematical investigations on the stability of aëroplanes are of the highest value, has, in some recent lectures at the Royal Institution, defined this term when applied to experiments in flight. A ship, as we know,

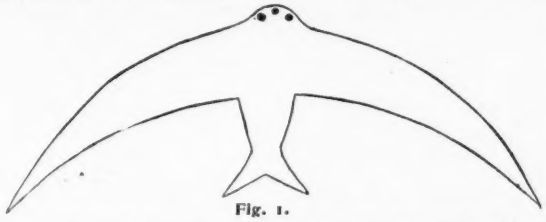


Fig. 1.

both rolls and pitches. An airship does the same thing, but its liability to pitch to a dangerous degree is greater than its liability to roll dangerously. Dr. Bryan suggests that any reader who wishes thoroughly to comprehend the subject should try a few experiments with paper gliders. A form of paper glider which was used with great effect by Dr. Hele Shaw at the *soirée* of the Royal Society serves the purpose best. The paper is cut so as somewhat to resemble in shape the wings and

Fig. 2

tail of a bird (Fig. 1). The tail may be slightly bent upwards, the wings turned over slightly downwards in front, and the glider, as we may call it, may be loaded with sealing wax or one or two small shot in front. If this form of glider is shot forward from the hand at the right speed for its weight and area, it may be made to travel in a series of waves, swooping down and slightly rising before taking another swoop. Small birds

Fig. 4.

flitting along the hedgerows may usually be observed to progress in these approximately regular waves (Fig. 2).

Now, when a wave strikes a ship sideways, the ship begins to rock; but the rocking motion subsides in consequence of the resistance of the water. "To secure stability it is only necessary that when the ship is thrown over on one side it should begin to swing back towards its vertical position. This is not sufficient in

Fig. 3.

the case of a flying machine. If such a machine should begin to tip over forwards, the pressure of the air may at first bring it back towards its proper position, but it may carry the machine too far beyond the proper position, thus causing it to tip over too much backwards. The machine may, again, swing forwards, and this time, after passing the proper position, it will tip over to a greater extent than it did the first time; in other words, the pitching motion may go on increasing till a point is reached when the machine capsizes. This is a kind of longitudinal instability quite different from anything with which the ordinary mechanic is familiar. In order to try and make this somewhat difficult point clear the accompanying diagrams have been drawn, of course, on an exaggerated scale. Fig. 4 represents the path of a flying machine moving from left to right, in which the pitching motion, as shown by the undula-

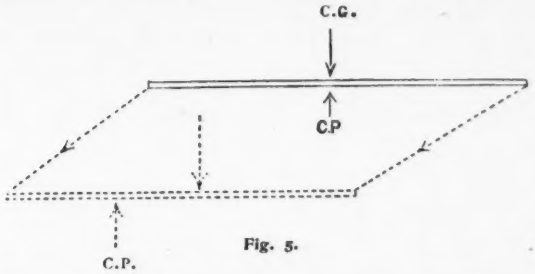


Fig. 5.

tions, subsides as the machine moves on. In this case the machine would be described as longitudinally stable, and would be safe to experiment with. Fig. 3, on the other hand, represents the case of a machine in which the pitching is small at first, but rapidly increases till the machine becomes uncontrollable."*

Dr. Hele Shaw, in the short address which he delivered at the Royal Society's *soirée*, offered an extremely clear and suggestive explanation of the causes

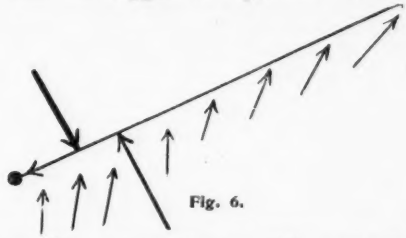


Fig. 6.

of the wave-like movement of a gliding aëroplane. If we suppose an aëroplane (which, for convenience of diagrammatic representation, we will regard as having a flat surface, though, in practice, the surface is curved) to be in static equilibrium, then its centre of gravity and its centre of pressure will be equal and opposite at its middle (Fig. 5). But directly the plane begins to move, the centre of pressure will advance to the front. As a matter of fact, in moving, an aëroplane, being

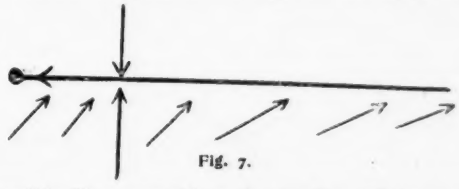


Fig. 7.

susceptible like everything else in the universe to the laws of gravity, must move downwards. It always moves downwards absolutely, though, owing to the upward pressure of the air beneath it, it may relatively move upwards. The truth of this proposition will become at once apparent if the hypothetical movements of an aëroplane in a vacuum are considered. It is the pressure of the air upwards which in every case sustains or lifts the aëroplane. In Fig. 6 and in the other diagrams which follow it the pressure of the air and the

* "The Problem of the Flying Machine," *Cornhill Magazine*, May, 1907.

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direction of the air current are indicated by the small arrows. Dr. Hele Shaw, by these diagrams, indicated what happens with the unstable aëroplane. In Fig. 6 the aëroplane is moving downwards, and the air current is escaping towards the rear, while, as the speed increases, the centre of pressure moves nearer the head of the aëroplane and nearer to the centre of gravity. (For convenience of illustration he supposed the centre of gravity of the aëroplane to be as in the case of a bird considerably nearer the head than the tail.) As the

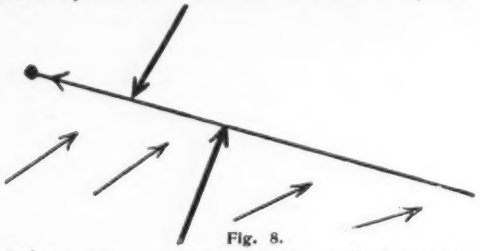

Fig. 8.

speed increases we know by Joessel's law that the centre of pressure will advance to the front. In Fig. 7 we may suppose that the speed of the aëroplane is exactly that which brings the centre of pressure opposite the centre of gravity, and that as a necessary result the aëroplane moves temporarily in a horizontal direction. The speed, however, will not be maintained, and the centre of pressure will move backwards again, as in Fig. 8.

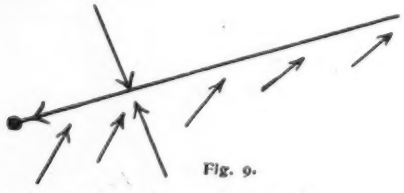

Fig. 9.

Tilting forward again, owing to the pressure of air rushing away at its tail, it recovers its speed in Fig. 9, and the centre of pressure and centre of gravity coincide again, *but this time while the aëroplane is moving downwards*. The speed increases, the centre pressure moves further forwards as in Fig. 10, and the inclination becomes more pronounced. In Fig. 11 we see what will

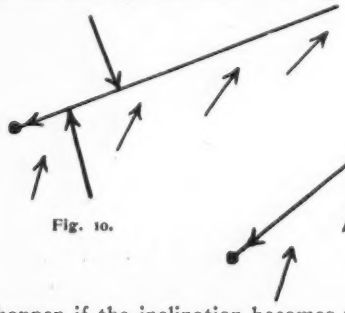

Fig. 10.

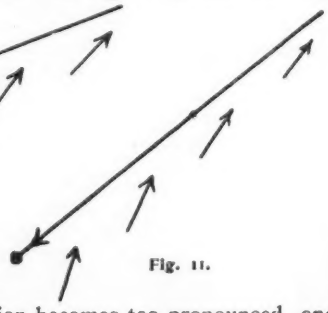

Fig. 11.

happen if the inclination becomes too pronounced, and if the aëroplane has not sufficient way to recover itself for a fresh upward plunge. In short, in Dr. Hele Shaw's opinion, the accidents to aëroplanes (and, incidentally, to birds) must always happen in consequence of the aëroplane or the bird pitching down head foremost. Taking into consideration the position of the centre of gravity of the falling objects, such a conclusion is inevitable. Some further observations, which we owe to Dr. Hele Shaw, on "Lateral Stability" will appear in our next number. E. S. G.

Hyperopia and the "Unilens."

By E. W. POLLARD, B.Sc. (Lond.).

THE little instrument patented by Major Baden-Powell, and called the "Unilens," has elicited some remarks of a critical nature in the columns of "KNOWLEDGE." It has been shown that a truly emmetropic person cannot see well through the Unilens, whereas a hyperope, or "long-sighted" person, finds great benefit from its use. The great prevalence of hyperopia is illustrated by the fact that the majority of Major Baden-Powell's friends can use the instrument. The why and wherefore of this may be of interest to readers of "KNOWLEDGE."

Let us consider a normal eye, represented in skeleton diagram in Fig. 1 A.

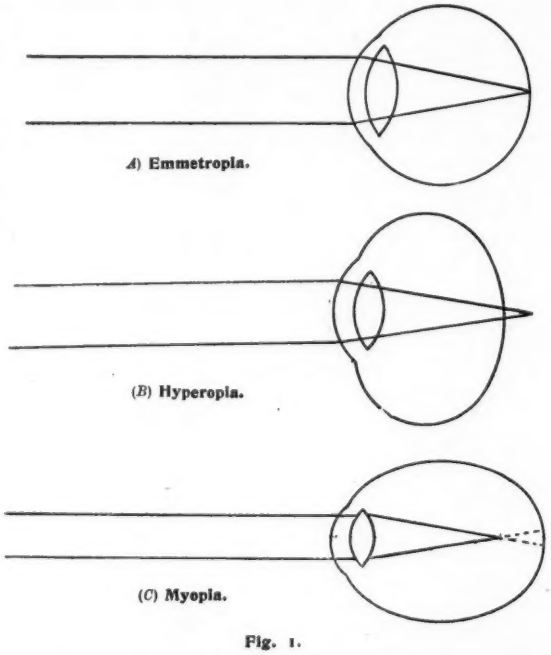

Fig. 1.

Parallel rays of light from a distant object are here shown focussed accurately on the retina at the back of the eye. But there are two kinds of rays in Nature—and only two—parallel and divergent. How, then, does the eye treat divergent rays—rays from an object nearer than 20 feet, for rays of light from a small object are considered parallel when that object is more than 20 feet away?

Everyone knows that, sitting near a window, it is impossible to see both a fly on the window and a distant church clearly at the same time. If parallel rays from the church are in focus, the divergent rays from the fly are blurred, and *vice versâ*. With an emmetropic person looking at the church, the eye is "at rest," but to see the fly, an effort, usually unconscious, is necessary.

This is an effort of "accommodation," and consists in exercising a ring of muscular fibres in the eye, around the lens. The position of these muscles is shown in Fig. 2—the ciliary muscle. At rest, the lens

is shown shaded; when we "accommodate" for a near object the lens is caused to bulge more forward, as shown in the dotted line, thus becoming more convex—its power of refraction being greater. The exact mechanism for doing this is a subject of dispute, and need not concern us here. Accommodating, then, is increasing the power of the lens of the eye, thus focussing parallel rays anterior to the retina, blurring the image, but bringing divergent rays from a near object to an accurate focus on the retina.

We see, then, how a normal eye is beautifully adapted for parallel and divergent rays of light.

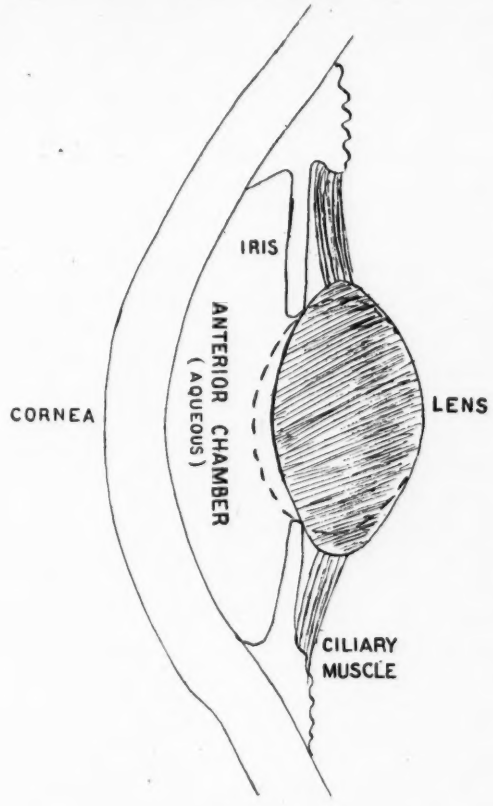

Fig. 2.

But parallel rays of light passing through the Unilens held some distance away are rendered convergent—a condition never found in Nature. An eye, then, that can focus unnatural rays must of itself be unnatural, and we will now proceed to see why this is so, and how it is that an unnatural eye can see well. Let us first bear in mind that the power of accommodation is greatest at birth and gradually diminishes throughout life; further, being a muscular effort, will vary enormously with different individuals and with the same individual in different states of health.

A hyperopic eye (Fig. 1, B) is usually a flattened eye, an undeveloped eye, being of less antero-posterior diameter than an emmetropic eye.

Parallel rays of light are, therefore, when the eye is in a state of rest—that is, when the accommodation is relaxed—brought to a focus behind the retina, and distant objects are blurred. But convergent rays will be focussed properly on the retina, and this is where the Unilens comes in. Looking at Fig. 3, we see that parallel rays are focussed to a point six feet from the instrument. If the eye is placed exactly at the focus nothing but a huge blurr is the result, but at any point between that and the lens a hyperope will see clearly, the distance depending on the degree of the person's hyperopia. At about five feet, if distant objects are clear, the person must have nearly three dioptres of hyperopia, or an emmetropic person must use a concave lens of this focus (13 inches). At three feet from the Unilens a person of 1.5 D. of hyperopia can see clearly, but the Unilens will be useless to a person of less than this amount of hyperopia unless it is held quite

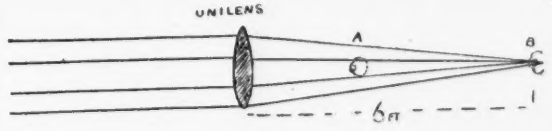

Fig. 3.

close to the eye. These remarks apply forcibly in the case of small astronomical telescopes; here we have a lens double the strength of the Unilens, and a hyperope of five dioptres or more can see stars well without an eyepiece. An emmetrope can, of course, do the same by using strong concave glasses.

The magnification, when using the Unilens, will depend on the distance it is held from the eye. In Fig. 3 an eye placed nearly 6 feet away will intercept more rays from a distant object than an eye placed at three feet, and the magnification will, therefore, be greater; but the degree of hyperopia must also be greater to focus these rays. In the Unilens, then, the rays of light are convergent, and the eye that can focus these rays is adapted to what is laxly termed "a distance greater than infinity." This is the case only when the accommodation is relaxed.

How, then, does a hyperope fare with parallel rays? Why, he simply exerts his ciliary muscle to cause the lens to bulge sufficiently to bring the rays of light forward on to the retina. But he is doing this unconsciously all day long, and herein lies the disadvantage of hyperopia. If the man is a farmer and is only using his accommodation sufficiently to focus parallel rays, his eyes will probably stand the constant strain of accommodation. It is when he has to do near work, or, in other words, to focus divergent rays, that he is at a disadvantage.

An emmetrope starts from a state of rest, the hyperope starts from a state of strain; and the latter, probably, soon begins to rub his eyes, for the ciliary strain is too much. A hyperope, when his defect is small, is unaware that his eyes are at all wrong except when reading, and this is the foundation for the statement repeated *ad nauseam* to an oculist or refractionist: "Oh, my eyes are all right—I can see beautifully, only they are weak in the evenings when reading." If anyone, looking through even the weakest convex lens, can see as well as without, that person is hyperopic, and should not only for present, but for future, benefit wear convex glasses constantly.

Hyperopia must not be confused with presbyopia or "old age sight," for in the latter case the eye is emmetropic, but with age the ciliary muscle stiffens, and is unable to focus near objects.

The articles on "Practical Aerodynamics" by Major Baden-Powell will be continued in our next number.

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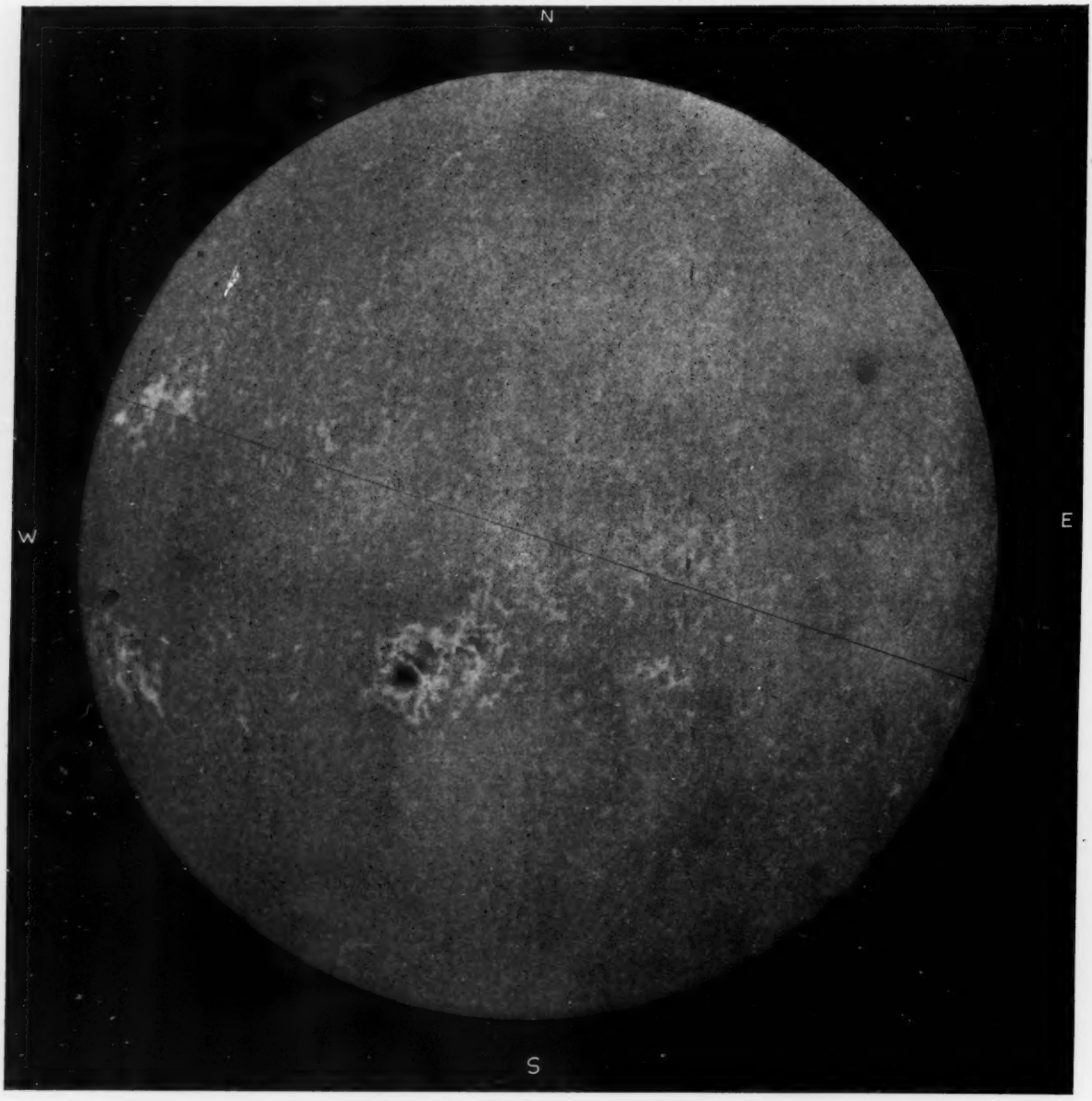
THE GREAT JUNE SUNSPOT.



Photograph of the Sun taken in "K" light on June 20, 1907, at 12h. 47m. p.m.

Taken with the Spectroheliograph of the Solar Physics Observatory, South Kensington.

The Late Professor Newton.

By the death of Professor Alfred Newton, which took place at Magdalene College, on Friday, June 7, Cambridge has suffered a severe loss. Born at Geneva, June 11, 1829, he graduated at Magdalene College in 1853, and from that date his distinguished career pursued the even tenour of its way until his death. During his early years he travelled much in wild places, visiting Lapland, Iceland, the West Indies, and North America, and this as Travelling Fellow of his College. Shortly after his return, he was appointed Professor of Zoology, which chair he held for just over forty years.

A naturalist in the best sense of the term, he yet showed from his earliest years a marked preference for ornithology, of which science he was the acknowledged leader in this country. To him we owe the earliest legislation for the protection of birds during the breeding season; and to his efforts the organised study of that most difficult of problems, migration, is very largely due. In all that pertained to extinct birds, and to species on the verge of extinction, he was keenly interested, and not the least valuable of his voluminous writings are those which bear upon the expiring faunas of the Mascarene and Sandwich Islands.

He has made for himself an undying monument in the two volumes of "Yarrell's British Birds," which he nominally edited, but really re-wrote; his great work on eggs, "Ootheca Wolleyana," and his "Dictionary of Birds," this last a reprint, with additions of his masterly articles in the "Encyclopædia Britannica." All that he wrote was good, scientifically, while few men of his time wrote with such a charm and grace of style.

His influence on the study of ornithology during the last fifty years has been profound; and not the least of his achievements was the part he played in the foundation of the British Ornithologists' Union. Though a disciple of Darwin, from the very first, and though he did all in his power to inspire and assist all who were engaged in any investigations tending to advance our knowledge of the Evolution theory, he himself contributed but little on this theme, and this probably because of his extremely cautious temperament. So strongly was this developed that it was extremely difficult to persuade him to express any opinions on that most difficult of all ornithological questions, the classification of birds. Rather than commit himself on this matter, to any accepted scheme, he cast the greatest of his works on his beloved study in dictionary form, the "Dictionary of Birds," yet on this account perhaps it will live the longer.

So far we have alluded to Professor Newton only in his public life; but those who have found in him a kind friend and a wise counsellor are many. To resident members of the University his rooms at Magdalene College were always open; and this both to undergraduates as well as to grave and reverend "dons." Here for more than forty years men of all opinions gathered every Sunday evening, and visitors from afar were no less heartily welcomed. They regarded such visits, indeed, as a rare privilege and delight, for Professor Newton was an ideal host, and made all men feel at ease when in his presence. Powerful as his influence has been during the forty years that he held the chair of zoology, the influence he wielded in his private relations with men, and especially the younger men, was probably far more potent, because more subtle, and as time goes on this will become more and more apparent. Of the great company that gathered together on Monday afternoon to see him laid to rest there was probably not one who had not more or less often enjoyed the charm of one of those Sunday night "At Homes," and there was certainly not one who did not leave his open grave with a feeling of having suffered an irreparable loss.

W. P. PYCRAFT.

ASTRONOMICAL.

By CHARLES P. BUTLER, A.R.C.Sc. (Lond.), F.R.P.S.

Photographic Study of the Spectrum of Saturn.

PHOTOGRAPHS of the spectrum of Saturn were obtained by V. M. Slipher at the Flagstaff Observatory, Arizona, during the autumn of 1905, for the purpose of investigating the absorption of the planet's atmosphere. A single prism spectrograph was employed, giving the low dispersion which is considered most suitable for depicting faint spectral bands, and the plates were sensitive as far as λ 6563 ($H\alpha$).

The slit was adjusted upon the major axis of the Saturnian system, and the spectra of the ansæ of the rings appear above and below the spectrum of the ball; the lunar spectrum was photographed alongside for comparison, care being taken to get the moon when it was about the same altitude as the planet, in order to eliminate as far as possible any absorption due to the earth's atmosphere. The solar light reaching the earth by reflection from the moon has the same spectrum as direct sunlight, and also the same as the sunlight that reaches Saturn, so that if different spectra are obtained the existence of an absorptive atmosphere surrounding Saturn will be indicated. Examination of the plates under low magnification revealed several absorption bands in the region between $H\beta$ and $H\alpha$. The bands at 5430 and 6193 are strong in the spectrum of the ball, but are not seen in the spectrum of the rings, thus indicating that if the rings possess any atmosphere at all it must be much rarer than that surrounding the ball.

A table is given showing the features of the various bands in the spectra of Jupiter, Uranus, and Neptune, and from an examination of this it appears that the planets which are telescopically similar have similar spectra; the spectrum of Jupiter resembles that of Saturn, while Uranus more nearly resembles Neptune. Certain differences are found, however; the bands at 5430 and 6193 are stronger in Saturn than in Jupiter, whereas the band at 6465 which is of considerable strength in Jupiter, is weak in Saturn. It is probable that we have here evidence of variations in the relative proportions of the various gases in the atmosphere of the two planets.

Special attention is drawn to the fact that none of the absorption bands in the spectrum of Saturn can be identified with these bands due to absorption in the earth's atmosphere, giving no evidence, therefore, for the existence of aqueous vapour.

Search for Intramercurial Planet.

During the total solar eclipse of August 30, 1905, three astronomical expeditions were organised from the Lick Ob-

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servatory to obtain photographs of the region surrounding the sun with the intention of determining if any planet nearer than Mercury was in existence. It had previously been shown during the eclipse of 1901 that there was no body as bright as the 5th magnitude. Stations were selected in 1905 at Alhama, in Spain, at Aswan, in Egypt, and at Cartwright, in Labrador, and the programme was satisfactorily carried out at the two former, but dense clouds prevailed in Labrador. Four cameras were employed at each station, covering fields about 29° by 9°. On all the plates stars as faint as 7.8 to 8.3 magnitude are well shown, but no object has been detected which could be an intramercurial body, and it is suggested that the result is sufficiently conclusive to indicate that some other explanation must be sought for the pecularities in the motions of Mercury.

The recent investigations of Seeliger on the effect of the matter concerned in the Zodiacal light upon the inner planets serve to show that the observed outstanding perturbations in the motions of Venus and Mars, as well as those of Mercury, can be sufficiently accounted for upon a reasonable assumption of the distribution of such matter about the sun.—(*Lick Observatory Bulletin*, 115.)

Distribution of the Minor Planets.

M. Stroobant has made an investigation of the elements of the minor planets with the object of determining their distribution with respect to the sun. The maximum "density" of asteroids corresponds to the distance 2.75, the numbers decreasing on either side of this value according to the usual law. Asteroids of fainter magnitude are less in number in the zones of denser aggregation.

Titanium Flutings in Spectrum of α Orionis.

A photographic study of the red end of the spectrum of some of the brighter stars has recently been undertaken by H. F. Newall and B. Cookson at the Cambridge Observatory with a four-prism spectrograph attached to the 25-inch refractor. Three strong flutings have been found, interpreted as absorption flutings, in the spectrum of Betelgeuse (α Orionis). Preliminary measures give the wave-lengths 7053, 7087, 7124, and it is interesting to note that Hale and Adams record prominent absorption flutings near these wave-lengths in the spectra of sunspots. This thus establishes a suggestive chain of evidence as to celestial chemistry. Fowler discovered flutings in the titanium arc-flame which agreed in position and intensity with absorption flutings in α Orionis. Then Hale and Adams proved the close resemblance between the special features of sunspot spectra and α Orionis, and later announced that they had been able to identify flutings in the sunspot spectrum as reversals of the bright flutings at the end of the spectrum as of the flame of the titanium arc. Finally the dark flutings have been detected in the red end of the α Orionis spectrum. Attempts have been made to detect these red flutings in β Geminorum and α Böotis, but the result is not quite certain.

BOTANICAL.

By G. MASSEE.

Physiological Life-Histories of Plants.

THE great importance of determining the physiological life-histories of plants in connection with the study of ecology is discussed by Dr. Garrong in the *Botanical Gazette*. From an ecological standpoint, there are four critical periods in the life-cycle of a plant. (1) The germination of the seed or spore; (2) the orientation of the seedling, whereby the plant secures a foothold upon its immediate surroundings; (3) the expansion into the adult condition; (4) flowering and production of fruit or of spores. It is not sufficient that the plant can accommodate itself to surroundings in three of these conditions, it must do so in all four. It is probable that dissemination introduces regularly into a certain habitat some plants which can germinate their seeds there, flourish as adults, produce flowers and fruit, but in which the seedling stem and leaves cannot bear the heat and light to which they are exposed, or in which the seedling root cannot reach the permanent water supply, hence such plants cannot survive in that locality. The author considers that it is to some such feature that of all the trees whose seeds reach the Miscou sand plains from the neighbouring upland the only one that can survive there is the white spruce, and, further, that many of the peculiarities of ecological distribution are determined by some such apparently trivial cause. But to explain such cases we must know the plants, and must know them throughout their life-cycles; and this is the essence of a knowledge of physiological life-histories.

The Flora of Ritigala: A Study in Endemism.

In the *Annals of the Royal Botanic Gardens*, Peradeniya, Ceylon, Dr. J. C. Willis gives a very interesting account of the flora occupying the summit of Ritigala, an isolated mountain rising abruptly on all sides, and occupying a position between the central mass of the Ceylon mountain system, the nearest point of which is forty miles distant, and the Palmis or other hills of Southern India, 280 miles away. The point of interest is that there occurs within about 100 feet of the summit of this mountain, within an area of a few acres, a remarkable flora, the components of which belong to the damper districts of Ceylon, whereas the mountain is situated in the dry region which, in turn, has its own characteristic flora. The fact that the summit of Ritigala is commonly cloud-capped at night, even in dry weather, and that during the south-west monsoon it is often constantly bathed in mist and perhaps rain, accounts for the presence of a flora belonging to the rainy region of Ceylon. The number of species found at or near the summit of the mountain is 144. From this number 41 species are eliminated, as they occur in the dry zone, and need not necessarily have travelled forty miles to reach the summit. The remaining 103 species, so far as the author is aware, only occur elsewhere in the moist region of Ceylon, *i.e.*, at least 40 miles away, and with few exceptions must have travelled in one journey over the whole of that distance, being species of the lower slopes of the mountains and not of the low country. Of these species, 49, on account of the small size of their seeds or spores (orchids and ferns), or by having the seeds or fruits provided with special arrangements, are evidently carried by wind; 24 species where the fruit is eaten by birds. These are all fairly common species, eight have scarlet fruits, five purple, one orange-red, one orange and white, four green or greenish-white, and three white. This suggests that conspicuousness of the fruit has something to do with its chance of being carried away by a fruit-eating bird. The means of distribution of the remaining 30 species is doubtful; some are possibly conveyed along with mud adhering to the feet of birds. Out of these 30 are six low-country species, which could reach the top by easy stages, leaving 24 out of which nine are endemic either as species or varieties.

On the other hand, in the plants of the dry zone, there is one endemic variety in 41 or more species; one very slightly marked form in 24 bird-carried species, and two endemic species and one variety in 49 wind-borne species. The author points out that endemism, other things being equal, goes in general with difficulty of distribution and with rare arrival in one spot.

Seasonal Effects on Plants.

In Bulletin N. 184 of the College of Agriculture, University of California, R. E. Smith states that one of the commonest troubles with fruit trees in the State is that produced by the vagaries of the climate. More especially in the coast regions of Southern California, the peaches and their relatives, also apples and walnuts, lose complete reckoning of the season, and suffer in consequence. Trees blooming in the autumn, remaining bare until July or August, bearing two crops of fruit a year, are amongst the evidences of this confusion. This has a disastrous result, such trees usually dying back to the larger limbs. If several uniform seasons follow, the trees may be able to form a new top, if not they perish.

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CHEMICAL.

By C. AINSWORTH MITCHELL, B.A. (Oxon.), F.I.C.

The Recovery of Waste India-Rubber.

OWING to the steadily increasing demand for india-rubber, mainly for electrical purposes and the tyres of motors and bicycles, the supply of crude material has become insufficient and there has been a consequent considerable increase in its price. This has led to increased attention being given to processes for the recovery and utilisation of waste rubber, and numerous patents with these objects in view have been taken out. An interesting review of the whole subject has been given by Mr. Walter Reid, in a paper recently read before the Society of Chemical Industry. Mr. Reid points out that if the rubber were made up in the form in which it is received by the manufacturers, the waste material would be of much higher value and more easy to deal with. But this is seldom the case, various mineral substances such as French chalk and magnesium carbonate being incorporated with the rubber, while the caoutchouc itself is partially replaced by substitutes usually consisting of oil, heated with sulphur, or otherwise solidified. All these impurities have to be separated, and enormously increase the difficulty of recovering the actual rubber from the waste substance. A still greater difficulty is due to the fact that india-rubber is usually heated with sulphur before use. This process of vulcanisation enables the rubber to resist changes of temperature, but in Mr. Reid's opinion is probably the cause of the rapid deterioration of modern rubber, the combined sulphur being slowly oxidised with the formation of traces of sulphuric acid, which act upon the caoutchouc and render it brittle. Pure, crude india-rubber will keep for a very long time, and pieces over 60 years old are known, which still show no signs of deterioration. Many of the processes of recovering rubber are based upon attempts to dissolve it by means of a suitable solvent, leaving the mineral and other impurities behind, but these have usually been upset by the fact that rubber that has been vulcanised is also practically insoluble in ordinary solvents. Excessive heating will convert vulcanised rubber into a viscous substance which can be mixed with fresh caoutchouc, but the overheating causes some decomposition, and the product is wanting in strength and elasticity. Part of the sulphur in vulcanised rubber may be extracted by a suitable solvent, but as a rule the bulk is retained, and the rubber is greatly deteriorated by the process. The most promising method yet tried is that patented last year in France, by M. Tixier. This is based upon the discovery that vulcanised rubber is completely soluble in terpineol, an alcoholic body, which is a natural constituent in certain essential oils, and is artificially prepared from turpentine oil. The waste rubber is finely pulverised, and heated in a closed vessel, with twice its weight of terpineol, the solution thus obtained treated with benzene to separate impurities, the benzene then expelled by evaporation, and the rubber finally precipitated from its solution by the addition of alcohol or acetone. About 5 per cent. of terpineol is lost in the process, and the remainder may be purified, when spent, by distillation in a current of steam, and used again. Rubber thus regenerated is said to resemble very closely the natural material, being strong and very elastic, and superior to the products obtained by any of the older processes.

The So-called Running of Glass.

In the manufacture of crystal glass, a fine, very adherent, blue deposit is frequently formed upon the surface, destroying the transparency. The phenomenon, which is known technically as "running," has been investigated by Herr Bauer, who has examined various specimens of such glass. He finds that the deposit gives none of the reactions for metals and is not soluble in acids, or removable by sublimation, though it is easily removed by treatment with strong caustic alkali solution. The deposit consists of sublimed silica, and its occurrence is to be attributed to the use of too wet material, and probably also to an insufficiency of basic substance. Under such conditions the superheated steam would volatilise the silica (for which the amount of potash was insufficient), and the latter would condense upon the glass during the process of after-heating. The trouble may be prevented by the use of previously-dried materials, which are carefully mixed, and, above all, by the use of a sufficient quantity of potash to fix the whole of the silica.

The Active Principle of Cobra Venom.

Many attempts have been made to isolate the active principle of cobra venom, but in none of these has the product been obtained in anything approaching a state of purity, and in the writer's opinion it is probable that the same objection applies to a substance termed *ophiotoxine*, recently prepared by Herr E. Faust from the dried venom. This is described as a light yellow amorphous body, which burns without leaving any residue, and contains no sulphur, phosphorus, or nitrogen. It dissolves with difficulty in water, yielding a solution which is extremely poisonous on injection, but the toxic effect of which is destroyed by alkali. It is stated to be a very weak acid with the formula, $C_{17}H_{26}O_{10}$ and to be precipitated from its solution by ammonium sulphate, but not by sodium chloride or sodium sulphate. It may be compared with *bufotaline*, a toxic substance separated by Herr Faust from the poison glands of the toad. Before *ophiotoxine* can be accepted as *the* active principle of cobra venom, it must be shown that it cannot be concentrated by further treatment into a still more active substance, and that it is capable of producing all the physiological effects of the fresh venom. The latter is improbable, for the results of all recent work point to the presence of more than one physiologically active principle in cobra venom.

GEOLOGICAL.

By EDWARD A. MARTIN, F.G.S.

Mud-Cones of the Mississippi.

FROM a consideration of the "mud-lumps" and the associated phenomena in the Mississippi delta, Mr. Wm. H. Hobbs has elicited some interesting conclusions, which he has published in the *American Journal of Science*. These small, isolated cones of mud often appear above tide, and have craters at their summits giving rise to a spring of dirty water at each apex. The water is often loaded with salt, oxide of iron, or lime carbonate, and carries mud and sand. It seems that these young craters have a distinct connection with the "blue clay bottom" on which the delta deposits have been laid down, the blue clay having been derived from a much lower layer of coast pliocene beds of Fort Hudson age. The accumulation of the delta mud and the settlement of the delta region is regarded by E. W. Hildgard as the cause of the forcing up of the mud-lump clay, together with the associated spring water. The water appears to be forced up from beneath the "blue clay bottom," and brings the clay up with it. The known existing freshwater springs at numerous off-shore points beneath the gulf probably have a similar origin, the artesian water stratum, so characteristic of the lower flood-plain, being apparently continuous beyond the coast-line. The mud-lumps are in reality mud-volcanoes, and their appearance differs only in degree, and not in kind, from the mud-volcanoes which result from seismic movements. Generally speaking, they have little connection with volcanic phenomena, and the name is not a happy one. Mr. Hobbs successfully points out that sand and mud cones and craterlets, together with sand and water fountains, are almost universally produced in connection with great earthquakes.

Where Mud-Volcanoes are Found.

The mounds of the "sunk-country," resulting from the New Madrid earthquake of 1811-12. are three or four feet in height, with diameters of 20 to 100 feet (E. M. Shepard). In Olivia, Texas, there are 59 mounds, of which the greater number are less than 30 feet in diameter, and seven inches in height (J. A. Udden). In Chemakha, Turkestan, mud-cones were raised as a result of the earthquake of February, 1902. Similar cones were found in a line running through

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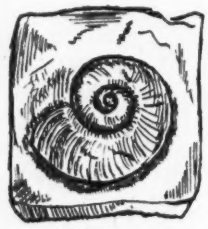
Sicily. They are found in Calabria, resulting from the earthquake of 1783; Iceland, 1896; and in India, 1897; in each case showing their connection with seismic phenomena. In a fossil state, they have been detected by Edward Greenly in the carboniferous limestone of East Anglesea.

Gault Clay Fossils.

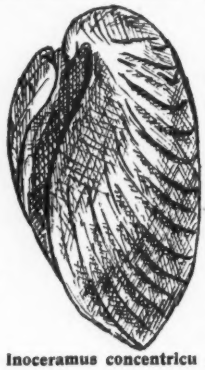
The Warren at East Wear Bay, Folkestone, will no doubt receive the usual complement of fossil hunters this season as in former years. The continual slipping of the Gault Clay at this picturesque spot constantly exposes fresh sections, whilst many of the more hardy specimens may often be picked up on the mud and sand below the cliffs. Fossils which may be specially looked for include *Nautilus*



Solarium.

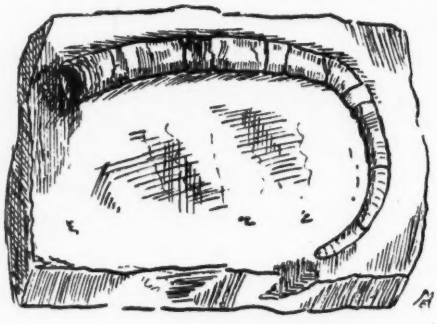
Actaeon affinis.

Nucula bivirgata.

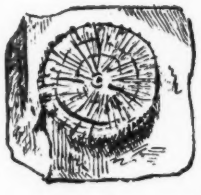


Inoceramus concentricu .

Inoceramus sulcatus.

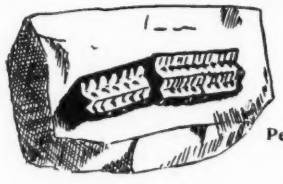


Serpula.



Thecosmilia.

Solarium conoideum.



Pentacrinites.

clementinus, generally pyritised, *Cucullaea glabra*, *Rostellaria carinata*, *Vermicularia concava*, *Kingena lima* (Defr.), *Aporrhais orbigniana*, *Nucula bivirgata*, *Venus*, *Rhynconella*, *Trochosmilia sulcatus*, *Pecten*, *Solarium*, *Pentacrinites fittoni*, *Hemiaster minimus*, and *Ammonites*, and other cephalopods of numerous species. Colonies of *Brachiolites spongida* in a pyritised condition will be found, together with numerous masses of pyrites of various shapes.

The Decay of the Stone-Work of Public Buildings.

It is regrettable that the stone-work of some of our public buildings is showing such serious signs of superficial erosion, and attention has for many years been devoted to the search which is constantly being made for some washing material —so to speak—which will stay the disintegration of the stone. The combustion of coal is responsible for the sulphuric acid which is present in the atmosphere, to which we must look as the cause of the atmospheric denudation. Various estimates have been made from time to time of the amount of the acid which is poured annually into the London atmosphere, and perhaps half a million tons may be held to be a fair estimate. Professor A. H. Church chose as his subject at a recent meeting at the Royal Institution, the conservation of urban stone-work and wall paintings. The limestone of some of our noblest buildings is becoming gradually coated with a layer of gypsum (sulphate of lime), and where the stone has been carved into mouldings and delicate tracery, the jarring and vibration caused by street traffic, etc., is sufficient in the end to destroy them. Professor Church gave a description of the remedy to be adopted, by the use of a solution of baryta. Where both limestones and sandstones were originally bound together by a cement of a calcareous nature, the action of the baryta is to re-convert the gypsum when formed into cement again of the nature of that lost. To prevent further action, the stone should be covered with a layer of paraffin wax. Practical builders have told me the difficulty they have had with stone facings which have lost the natural cement which has formed on the surface of quarried stone when in the soft state, and hence its customary exposure until it has got rid of some of its quarry-sap. If the surface obtained is destroyed in cleansing, as it is feared is sometimes the case when steam and sand-blast is used, it has hitherto been no easy matter to arrest rapid disintegration. Professor Church has shown the way by which, with suitable treatment, it may be arrested.

METEOROLOGICAL.

By W. MARRIOTT, F.R.MET.SOC.

THE International Commission of Scientific Aerostation, has resolved to carry on during the years 1907 and 1908, the investigation of the upper atmosphere in the Northern Hemisphere on a more extended scale than has hitherto been attempted. In addition to kites, pilot balloons carrying self-recording instruments, and also smaller balloons, are to be used, the heights and drift of which will be

determined by theodolites. The special ascents in 1907 are to be made on July 22 to 27; September 4 to 6; and November 6 to 8; one balloon to be sent up on each of these days.

Mr. F. Campbell Bayard recently read a paper before the Royal Meteorological Society on "Weather and Crops, 1891-1906." In this he gave an analysis of the agricultural and horticultural tables which are included in the annual "phenological reports." He had sorted out the various crops into "good," "average," or "bad" for each district, and against each he had placed the temperature, rain, and sunshine for the four seasons, and whether these statistics were above or below the average. He gave tables showing the general results with regard to wheat, barley, oats, beans, peas, potatoes, turnips, mangolds, hay, clover, apples, pears, plums, raspberries, currants, gooseberries, and strawberries.

A paper was read at the same meeting by Dr. C. P. Hooker, on "The Relation of the Rainfall to the Depth of Water in a Well." The author gave the weekly measurements of the depth of water in a well 101 ft. deep at Further Barton, Cirencester, compared with the weekly rainfall for the years 1903-1906. The results were very interesting, as they included the remarkably wet year 1903, and the droughty summer and autumn of 1906.

Dr. W. N. Shaw, F.R.S., who holds the appointment of Reader in Dynamical Meteorology at the London University, has recently given a course of six lectures on that subject at University College.

Mr. Ernest Gold, M.A., has been appointed by the Meteorological Committee to the Readership in Dynamical Meteorology at Cambridge University, which has been founded through the generosity of Professor Schuster, F.R.S. This post is tenable for three years.

Mr. Andrew Watt has been appointed Secretary to the Scottish Meteorological Society, which was rendered vacant by the death of Dr. Buchan, F.R.S.

As this is the period during which summer thunderstorms are likely to occur, observers should carefully note the times of the lightning flashes, the thunder, rain, hail, and changes of the wind. Photographs of lightning, and also of any damage that may occur should be taken if possible.

Observations taken during thunderstorms, and also photographs of any meteorological phenomena should be sent to the Royal Meteorological Society, 70, Victoria Street, Westminster, S.W.

ORNITHOLOGICAL.

By W. P. PYCRAFT, A.L.S., F.Z.S., M.B.O.U., &c.

The Sparrow Plague in America.

THE last issue of the *Auk* contains a valuable summary on the present status of the "English sparrow" in America, where, since its introduction in 1850, it has become a pest, not only on account of its greed for grain, but also because it has slowly but surely ousted far more valuable birds. In the whole of the States east of the Rocky Mountains, it has increased to enormous numbers, which no efforts have yet succeeded in reducing. Australia and New Zealand have the same story to tell. And the same is true in Great Britain, where this ubiquitous bird is steadily crowding out the sand and house martins.

Sociable Plover in Kent.

At the May meeting of the British Ornithologists' Club, Mr. C. B. Ticehurst exhibited a specimen of the sociable plover (*Vanellus gregarius*), which had been shot from a flock of six in Romney Marsh, Kent, on May 3, 1907, by a shepherd. This bird proved to be a female in its first plumage. Only twice previously has this species been recorded as occurring in Great Britain, the first of these dating as far back as 1860.

Barred Warbler in Kent.

At this same meeting Dr. N. F. Ticehurst exhibited a barred warbler (*Sylvia nisoria*), one of two examples, both males, which had been killed at Woodchurch, Kent, on April 24, 1907. These are the first specimens of the species which have, so far, been recorded from the county of Kent, and they bring up the total number of occurrences in these islands to twenty-one. All the previous birds, it is to be noticed, were obtained in the autumn.

Red-Breasted Fly-Catcher in Yorkshire.

Mr. Ben Haworth Booth writes to the *Field* (May 25) to say that he saw a male red-breasted fly-catcher near Hull on May 20. Altogether about a dozen examples of this bird have been shot in various parts of the United Kingdom since 1863; and most of these were obtained during the autumn.

PHYSICAL.

By PROF. ALFRED W. PORTER, B.Sc.

The Effect of High Temperatures on Radium Emanation.

MR. W. MAKOWER showed last year that when radium emanation is sealed in a quartz tube the activity is temporarily changed by subjecting it for a short time to temperatures between 1,000° C. and 1,200° C. From the results obtained, it seemed probable that this change was not due to any alteration in the emanation itself; but rather to a change in activity of one of the more quickly decaying products of the emanation with which it is in equilibrium. In order to remove any doubt, Messrs. Makower and Russ have now measured the rate of decay of the emanation when kept at a temperature of 1,100° C. The experiments indicate that the rate of decay is unaltered by the difference in temperature, the activity falling to half its value in 3.88 days. We may point out that the value obtained by Sackur is 3.86 for emanation kept at ordinary temperatures.

Further experiments which they have made on the "active deposit" on platinum wires make it probable that radium C undergoes a sudden change when subjected to a high temperature, its activity being thereby diminished. On the other hand, radium B is unaffected by such treatment.

Osmotic Pressure and Surface Tension.

Following van t'Hoff, it is commonly held that osmotic pressure (that is, the difference of hydrostatic pressure on the two sides of a semi-permeable membrane, when the liquids on the two sides are in equilibrium) is a consequence of the molecular collisions of the dissolved substances upon the walls of the vessel; in other words, that osmotic pressure arises in the same way as the pressure of an ordinary gas. Attempts have often been made to attribute the pressure to a difference in surface tension of the solution and the pure solvent. Thus, for example, Traube concludes that the more the osmotic velocity of a substance soluble in water is raised, the more does this substance lower the surface tension of water when dissolved in it. On the contrary, substances which cannot traverse membranes increase the surface tension of water. This relation leads him to suppose that it is "the difference between the surface tensions which determines the direction and the velocity of osmosis."

Experiments have been brought forward which bear against this conclusion. Batelli and Stefanini have recently remodelled the statement so as to be in accordance with all known facts. In their opinion, the osmotic flow must take place in each case in that direction which most readily tends to equalise the surface tensions of the two liquids which are separated by the semi-permeable membrane. To give an example: Solutions of salicine cannot pass through a membrane of ferrocyanide of copper (or, at any rate, only with great difficulty); they cannot then diminish the surface tension by passing over to the side of the pure solvent. The only motion that can occur is that of water toward the solution, and every dilution of the solution increases the surface tension of the solution, and thus tends to equalise—in the only manner really possible—the tension on the two sides of the membrane.

Amongst other interesting facts which they bring to light

is that two solutions exhibit no relative osmosis when their *surface tensions* are equal, and not (as van t'Hoff thought) when they are equi-molecular. For example, they find that a solution of $MgSO_4$ of 1.78 per cent. has the same surface tension as a solution of Na_2SO_4 of 1.11 per cent.; and that these solutions balance one another when on the inside and outside of a semi-permeable cell. In such a case it might be a difference in electrolytic dissociation which was the cause of the difference. Similar results are found, however, for solutions of sugar and mannite.

Interesting though these indications of connection between osmotic pressure and surface tension undoubtedly are, we are not sure that the results tell finally against the kinetic origin of osmosis. The expectation that equi-molecular solutions should possess the same osmotic quality is one which relates only to very dilute solutions. The law of Avogadro, which is the similar theorem for gases, is in reality not true; and we should therefore not be surprised if the corresponding theorem for solutions should also fail to be true. In neither case would this failure justify one in denying the large part played by the motion of the particles in producing the observed pressure. All that we would be entitled to infer is that other causes are contributing to the total result.

Does the Æther Flow Along Magnetic Lines of Force?

In the *Philosophical Magazine* for June, Sir Oliver Lodge paraphrases an argument of Professor Hicks, to show that whatever be the kinetic nature of a magnetic field, it cannot consist of mere irrotational ætherial streaming. The paraphrase is this:—A conductor moving across a magnetic field generates an E.M.F. If the magnetic field itself were nothing but locomotion of æther along the lines of induction, then that motion could be compounded with the motion of the conductor, so as to be equivalent to a stationary conductor in a field inclined at some different angle. But in a stationary conductor no E.M.F. is generated. Therefore when a conductor moves so as to generate E.M.F. it must cut a *structure* of some kind, not a mere flow. The suspected magnetic streaming, therefore—though not negatived—must be regarded as a superfluity and becomes improbable.

ZOOLOGICAL.

By R. LYDEKKER.

An American Golden Mole.

No animals are more characteristic of Central and Southern Africa than the burrowing golden moles (*Chrysochloridæ*), which take both their popular and their scientific names from the iridescendent metallic sheen of the fur of the southern species. Although they belong to the same order (Insectivora) as our own mole, they are structurally very different from the latter, and in this respect come nearer to the tenrecs (*Centetidæ*) of Madagascar, which, in their turn, are related to the West Indian solenodons (*Solenodontidæ*); this sporadic and isolated distribution of the different family groups being an indication of the great antiquity of the order. A few years ago remains of a fossil representative of the family were discovered in the Tertiary deposits of Patagonia, whereupon an American naturalist declared that we had now positive and indisputable evidence of a former land-connection between Africa and South America. This statement was uttered at one of the meetings of the British Association in South Africa, and its positive nature elicited a word of warning from a well-known English naturalist. This warning has proved to be prophetic, for quite recently remains of extinct golden moles have been found in the Tertiary rocks of the United States, thus conclusively proving that the evidence of this group, at any rate, is of no sort of value in regard to a former connection between Africa and South America. The moral of all this is the advisability of regarding all theories of continental connections as purely hypothetical and provisional.

The Porcupine's Tail.

It is now generally admitted that the rattle of the rattlesnake and certain structures connected with the mechanical production of sound in some scorpions and giant spiders come under the designation of warning organs; that is to say, the sounds they produce are intended to give notice of the approach of a dangerous creature. How this arrangement works in the case of carnivorous creatures like rattlesnakes, which, one would think, must drive away their own prey, we are not told; but no doubt the believers in the theory have a full and satisfactory explanation of the difficulty. No such difficulty arises in the case of the porcupine, whose tail, according to Mr. R. I. Pocock, has a function similar to that of the snake's rattle. Unlike most nocturnal animals, porcupines, when prowling about at night, make as much noise as possible by rattling their quills and continually grunting. In spite of their array of spines, porcupines, according to Mr Pocock, are easy to kill on account of their thin skins, which are easily torn. A properly trained dog, who knows where to get a safe grip, will shake a porcupine to pieces in a few seconds. Hence the object of endeavouring to frighten other animals by bluster; the porcupine, in fact, playing a bold game of bluff.

The Horse's Skull.

Most readers are probably somewhat weary of the subject of the origin of the thoroughbred and the relation of that animal to more humble strains. If they are not, they may find something to interest them in the April number of the *Quarterly Review*, where it is shown that skulls of domesticated horses differ to a remarkable degree in regard to the extent to which the face is bent down on the main axis. These differences are shown by photographs, and are, therefore, incontestable. In the text it is stated that the wild Mongolian horse has a skull of the bent type, and is, indeed, regarded as the representative of that type: and in another paper by the same author a skull referred to this species is figured, in which the bending down is shown. On the other hand, an undoubted skull of this race, exhibited in the North Hall of the Natural History Museum, is certainly of the straight type.

Papers Read.

At the meeting of the Zoological Society held on May 7, Mr. W. E. Hoyle read a paper on squids and cuttlefishes from East Africa, in the course of which it was shown that certain species were identical with Cingalese forms. Small mammals from Korea formed the subject of a paper by Mr. O. Thomas; while buildings in Continental menageries were discussed by Mr. A. Trevor-Battye. The form of the brain in Malagasy fossil lemurs, accompanied by some remarks on the relationship of the living indri, formed the main topic at the meeting of the same Society on May 28, Mr. J. Elliot Smith being the author of the paper. The anatomy of the shark *Chlamydoselache* was discussed the same evening by Mrs. O. A. M. Hawkes; while Mr. Boulenger discoursed on South African reptiles, and Mr. J. Ritchie communicated a paper on hydroid zoophytes from the Cape Verde Islands.

REVIEWS OF BOOKS.

ASTRONOMY.

Harvard College Observatory Publications.—We have received the 61st Annual Report of the Director, Professor E. C. Pickering, and were at once struck with two things, one, the far-reaching activity of the Observatory in the many different lines of research undertaken, and the other, the fact that in spite of the very excellent "value for money" offered, the fountain of American generosity to science seems in this particular direction to be running dry, since the visiting committee failed to raise more than a third of the sum (£10,000) urgently required by the Director for a fireproof library, a great mass of printing, and a fresh branch of activity for which the materials are at hand. This is very much to be regretted, as Professor Pickering's powers of organisation make him a past-master of the difficult art of making a little money go a long way, which ought to have pleaded his cause efficiently with the American plutocrats. Perhaps he asked too little, so

that the money kings left the appeal to others. The present activity of the Observatory shows no sign of slackness, however. Fourteen thousand photometric comparisons with the East equatorial, including many eclipses of Jupiter's satellites, were made during the year (ending September 30, 1906). In the last eight years an average of 72,000 settings with the 12-inch meridian photometer have been made annually, thus practically completing the work for which it was intended. The 5-foot reflector is not yet mounted, so that the faintest stars are not included in the photometric survey, but it is probable that the improved methods of photographic photometry will obviate the necessity of devoting much of its time to visual photometry. The Draper memorial work goes on as usual. Mrs. Fleming adds steadily to the number of new variables, peculiar spectra, and other special classes, the number of stellar photographs taken in the year being 4,580. At Arequipa, under the charge of the senior assistant, R. H. Frost, rather more than half as many photographs have been taken, one of the telescopes having to be sent away for repair after twenty years' work During the year 12,000 photometric settings were made at Arequipa. The Bruch photographic telescope has not been idle. It is the most valuable instrument there and can photograph spectra of fainter stars better than any other telescope under Prof. Pickering's direction. Some of the long-exposure plates show more than 300,000 stars. The Blue Hill Meteorological Observatory still takes a leading place in American meteorology, under the able direction of A. L. Rotch, especially in the exploration of the upper air by kites and *ballons sondes*, some of the latter reaching a height of 10 miles. But we must say a few words as to the year's publications, which consist principally of portions of three separate volumes of the Annals. Vol. LII., Part I., consists of observations of eclipses of Jupiter's satellites, 1878-1903, by the photometric method. A single observer can make about three comparisons per minute, the normal duration of disappearance of the four satellites being 4, 5, 10, and 13 minutes respectively. With one additional assistant seven or eight settings per minute could be obtained and with two as many as thirteen (*i.e.*, one in five seconds). The total number of phenomena observed was about 700, and a full description is given of the different photometers and the methods employed. Vol. LV., Part I., consists of Miss Cannon's second catalogue of variable stars, giving all the essential information about nearly 1,300 variables, including name, place, range, period, type, discoverer, etc., with most copious notes, especially on doubtful stars and new stars. A supplementary list of nearly 200 recent discoveries is not quite so full of detail, many of the periods being not yet determined. Vol. LX., Part III., contains positions of Phœbe, 1898-1904, deduced from photographs, by Professor Turner's method of rectangular co-ordinates, the measures being made according to plans given in Vol. LIII. of the Harvard Annals.

BIOGRAPHY.

Thomas H. Huxley (English Men of Science Series), by J. R. Ainsworth Davis (London: Dent and Co., 1907; pp. xi. and 288, portrait; price 2s. 6d.).—The author of this excellent little biography has been fortunate in two ways. In the first place, he has had one of the most striking and original personalities of the 19th century, and at the same time a great master in science, for his theme; in the second, a larger and more comprehensive life of the great biologist lay ready to his hand from which to cull materials. His indebtedness to that biography is fully acknowledged by Professor Davis, who has, nevertheless, by no means confined himself to the materials therein contained, or to the opinions expressed by the biographer. As is only proper in a scientific biographical series, the author has mentioned merely such personal details as are essential to a right understanding of his subject, and has concentrated attention on the life-work of his hero. Huxley was a great controversialist and debater, and his advocacy of the Darwinian theory in its early days and his strongly pronounced views on education made him better known to the general public in connection with these subjects than in relation to his proper scientific work. His biographer is, however, strongly of opinion that when sufficient time has elapsed to place his life in its proper focus, Huxley's claim to the regard of posterity will rest on his scientific work, and especially his physiological investigations, rather than on his ability as a controversialist and his advocacy of important social changes. Although this is very probably a true conception, yet the character of Huxley, and especially his hatred of all humbug and begging-of-the-question, must always stand out as a brilliant example. His dictum, too, that learning and cleverness are of little or no value unless accompanied by energy and intellectual grip, is one that should be taken to heart by all. Although we may deplore that the very greatness of his intellect would not permit him to accept all the orthodox ideas of religion, a truer-hearted man or a more brilliant example we shall seldom see. Mr. Davis may be said to have done his work in a style worthy of the greatness of his subject.

BOTANY.

The Botanists' Album for Pressed Flowers (W. and A. K. Johnston, Ltd.; 5s. net).—This album is just the thing required by those interested in "Nature study," or plant ecology, for although in some quarters it is stated that such studies are more instructive than the botanical teaching of past times, nevertheless, without a sound knowledge of the structure of plants, at least so far as those minute points of detail bearing on classification are concerned, but little progress can be made in the study of ecology. The album is well bound, and the pages (11½ ins. by 12½ ins.) consist alternately of stout paper for mounting a dried specimen upon, and a thinner page on which is printed a "plant schedule," containing the headings of all points to be noted in completely describing a plant botanically, including space for general remarks, etc.

METEOROLOGY.

Stonyhurst College Observatory: Results of Meteorological and Magnetical Observations, with Report and Notes of the Director, 1905.—This small annual is deserving of more than a simple acknowledgment, inasmuch as besides furnishing a complete set of monthly meteorological tables for the year 1905, it provides summaries, means, and "records," going back for 58 years, and, in addition to its meteorological portion, gives regular magnetical observations, Stonyhurst being one of the (unfortunately) few well-equipped magnetic stations in the United Kingdom. Work, when possible, is also done in connection with sun-spots, nearly two hundred drawings having been made during the year. It must be admitted, however, that as a model for other observatories, this book falls unexpectedly short of perfection. Some obvious slips may be attributed to careless proof reading, but there are other matters requiring attention. In deducing a mean temperature it is advisable to state the process of deduction. In every month of 1905 the deduced monthly mean temperature is the actual mean of all the daily maxima and minima, *i.e.*, no correction is applied. It is obvious, however, that some seasonal correction has been used elsewhere, for the corresponding figures for the whole 58 years differ in every case except December from the mean of the daily maxima and minima, the difference in one case being more than two degrees. The absence of the explanation of this anomalous appearance is liable to cast doubts on the validity or homogeneity of the series. But to give an instance of what seems to be actual carelessness as distinct from want of detail; turning to the summary of sunshine, extremes for the last 25 years (p. 32), starting with one obvious error at the foot of the page which is at variance with the corresponding figures on the opposite page (p. 31), we find four more inaccuracies in the same element, betrayed by a comparison of the 25-year summary with the only year available for the purpose (1905). This naturally discounts the reliance we might be expected to place upon the whole summary, and, consequently, upon the other summaries in the report, as we have no evidence that similar mistakes have not been passed in previous years. We trust that before the next annual report appears, time may be found for a certain amount of revision.

TELESCOPES AND FIELD GLASSES.—Mr. J. H. Steward has sent us a copy of the new edition of Part I. of his catalogue, comprising a wide range of astronomical and portable telescopes, as well as prism and ordinary pattern field glasses. The list also includes driving clocks, transit instruments, and other astronomical accessories.

XUM

MICROSCOPY

Conducted by F. SHILLINGTON SCALES, B.A., F.R.M.S.

The Preparation of Microscopical Objects.

(*Continued from page* 142.)

I have already mentioned that it is advisable as far as possible to avoid pressure when making mounts in any of the glycerine media, and a further safeguard is the leaving of a small air bubble under the cover-glass with which to counteract changes in temperature. This method, though it looks untidy, works well in practice, and in the slide cabinet of the Royal Microscopical Society are slides which have been treated in this way, and which have been long mounted. The preliminary soaking must not be neglected, and in many cases the object should soak in glycerine of the same strength as that in which it is to be ultimately mounted, or the subsequent swelling may assist in loosening the cement.

Alcohol attacks cement, and, therefore, glycerine, alcohol, and water, a formula for which was given on page 142, is used mainly for delicate objects whose sudden immersion in strong glycerine would be harmful. By refraining from closing the mount for a few days the alcohol evaporates, and the glycerine and water are left.

We have now to deal with mounting in *Canada balsam*. Canada balsam has a considerably higher refractive index than glycerine (1.535 for Canada balsam as against 1.456 for pure glycerine, and 1.397 for glycerine and water in equal proportions), and as mounting media should be selected to give as great contrast as possible between the tissues and the mounting medium, tissues which have a low refractive index requiring a medium of high refractive index, and tissues of high refractive index requiring a medium of low refractive index, this fact is worth bearing in mind. But Canada balsam, being a resinous medium, is of all media the most preservative for the object, and the most permanent. It is necessary to dissolve the balsam in some suitable solvent, and those generally used are turpentine, chloroform, xylol, or benzole. Turpentine balsam sets more slowly than any of the others, and the mount has, therefore, less tendency to become brittle, and Mr. Lee points out that the index of visibility is retained longer with this solvent than with those which are more volatile, but it is unfortunately injurious to alum-hæmatein stains, whilst the chloroform solutions have a tendency to turn brown with age. It may be added that all solvents of Canada balsam are injurious to the coal-tar stains, and prevent their permanency, so that the selection of both stain and mounting medium requires some consideration. Dr. Mann likewise points out that the balsam itself must be neutral, the commercial balsams being always acid and, accordingly, discharging the basic dyes. For this reason it is best to buy Canada balsam from the opticians, especially from those who stock the well-known preparations of Grübler. Personally I prefer to use balsam dissolved in benzole, but the benzole must be pure and absolutely free from water. It has a rather high refractive index, and it sets somewhat quicker than xylol, but I have found this an advantage rather than otherwise, and it is more stable than xylol with regard to alkalies.

Canada balsam, whatever the solvent, should be of the thickness of syrup. It should be kept in a capped bottle, the bottle having a fairly wide mouth and being provided with a glass rod. The cap should be kept on the bottle as much as possible in order to minimise the evaporation of the solvent, but more solvent can be added if necessary. The older the balsam the better. I have already pointed out that it absorbs air bubbles rapidly, and the thinner the solution the more rapidly will these oxidative processes go on, so that minute air-bubbles in a mount can generally be neglected. I have also laid stress on the fact that all moisture must be rigidly guarded against not only in the object which is to be mounted, but even by such means as breathing on the cover-glass, a plan which I have unfortunately seen even recommended!

There is only one practical way of extracting water from tissues, whether it be inherent or acquired—*dehydrating* as it is technically called—and that is by means of alcohol. A robust section may be put into strong alcohol direct from water, but in most cases the section will become distorted or torn by such treatment, and, therefore, graduated alcohols are used. A suitable graduation would be to have alcohols of 30 per cent., 50 per cent., 75 per cent., and 95 per cent. strengths. Elaborate tables have been made out for calculating these strengths, but these are not really necessary. One or two points should be borne in mind; firstly, that the amount of alcohol should be ample at each stage; secondly, that each process should not be hurried; thirdly, that alcohol rapidly absorbs water from the air. It is well, therefore, to provide stoppered stock bottles of the above strengths, and also short wide-mouthed, stoppered bottles of such a size that a 3 by 1 inch slide can be inserted entire. These last bottles can be used a good many times unless work requiring special care is being done, but in all cases the bottles should be kept stoppered, and if alcohol is used in a watch-glass, another watch-glass should be placed above it.

Absolute alcohol is fortunately very rarely necessary, as it is very expensive, the clearing agents being able to remove a small amount of water, so that 95 per cent. alcohol is quite sufficient provided the warning already given be acted upon and the bottle kept rigidly stoppered. It is surprising how soon so strong an alcohol will absorb water and thus spoil a series of sections. For many sections good methylated spirit may take the place of alcohol, but it must form no precipitate with water.

The time required for each stage of dehydration varies with the size of the section. Thin sections that have been cut in a microtome may not require more than two or three minutes, whilst other tissues which contain much water require as much as 24 hours. The worker will learn to exercise his own judgment, remembering that an extension of time can do no harm except, perhaps, to make the section a little more brittle. Of course, alcohol discharges the colour from many stains, but such matters I shall leave over until we discuss staining processes themselves. The last strong alcohol should always have full time given to it.

(*To be continued.*)

Royal Microscopical Society.

May 15.—The Rt. Hon. Lord Avebury, P.C., F.R.S., in the chair. Professor A. W. Porter read a paper by himself and Mr. P. F. Everitt on "Diffraction Rings

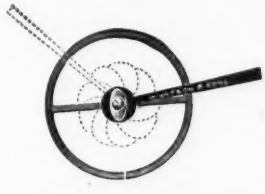
Due to a Circular Aperture." He considered the differences between the theoretical and the observed radius of the first dark diffraction ring mentioned in Mr. Nelson's paper (read March 21, 1906) must be due to the method of observation, because the values obtained from observations made by Mr. Everitt, under the best conditions, were in very close agreement with theory. A discussion ensued in which Messrs. Gordon, Conrady, and Beck took part, and to which Professor Porter replied. The President called attention to the Society's annual exhibition of Pond Life, displayed under about 40 microscopes, in which the Fellows of the Society had been kindly assisted by members of the Quekett Microscopical Club.

Quekett Microscopical Club.

May 17.—In introduction to a paper on "Some Littoral Gatherings of Foraminifera from Victoria, Australia," by Mr. F. Chapman, A.L.S., F.R.M.S., Mr. A. Earland gave a short account of the methods usually employed in collecting and cleaning gatherings of Foraminifera for examination. After describing at some length the characteristics and main features of the group, Mr. Earland dealt with the Dimorphism of the Foraminifera. This term, as now used, refers to the difference in size of the first, or "primordial," chamber of the test. Observations many years ago showed that nummulites were often associated in "pairs of species," one species being small, the other large, and the smaller specimen always had a large primordial chamber and the larger species always a very tiny one. Subsequently Munier-Chalmas expressed the opinion that these pairs were but forms of the same species, and, with Schlumberger, found that many other genera and species showed similar differences. Much has recently been done on the living organism by Schaudinn in Germany and Lister in this country. These differences between the two forms, now known as megalospheric and microspheric, were dealt with at some length, and Mr. Earland concluded his remarks with a very interesting account of the methods of reproduction of the group. Mr. Chapman's paper consisted chiefly of descriptions, with a detailed distribution table, of some 103 species met with in gatherings from seven localities.

Journal of the Quekett Club.

The April issue of this Journal contains a summary by Mr. J. Burton of the Reproduction of Mosses and Ferns, which, without claiming to be original, summarises clearly enough the true meaning of what is generally known as the "alternation of generations" in these plants, and which would have been even more useful to the members had greater stress been laid on the homologies between mosses, ferns, gymnosperms, and the higher flowering plants. Mr. F. P. Smith contributes an illustrated paper on the classification of the British spiders of the genus *Lycosa*, Mr. A. E. Hilton a somewhat indeterminate paper on the chemical conception of living organisms, and Mr. James Murray an interesting paper on the *Tardigrada*. The President's annual address on "Photo-micrography" adds little to our knowledge of the subject. Mr. W. R. Traviss contributes a note on an expanding stop for dark-ground illumination, designed to utilise the principle of the iris-diaphragm so as to give a stop which would vary in size and thus enable the best results to be obtained with ease with objectives of varying apertures. The suggestion has already borne fruit, a stop on the principle advocated by Mr. Traviss having been worked out by Mr. Ausbuttel, and promptly put upon the market by Messrs. W. Watson and Son, and also, I believe, by Messrs. J. Swift and Son. I am indebted to the former firm for an opportunity of trying the stop (which fits in the ordinary ring beneath an Abbe condenser, and is most convenient and efficient), and also for the loan of the accompanying illustration, which will make the principle clear to my readers.



The Keeping of Volvox.

In the *American Naturalist* a writer gives a method by which Volvox can be kept alive for weeks. The water containing the organism should be collected in considerable quantity, together with a small amount of such vegetable material as duck-weed, *Riccia*, &c., and placed in shallow glass dishes, which are then covered with glass plates and placed near windows. When exposed to direct sunlight the covering plate should be raised slightly in order to allow for efficient ventilation, and to prevent too great a rise of temperature. The water does not require to be changed. Should there be too many Crustacea and other harmful animals present, the water must be first filtered through bolting-cloth. A moderate amount of decaying plant or animal matter seems to be necessary for the existence of Volvox, and they are more easily kept alive in cool than in warm weather. Abundant material in the sexual stage was obtained in the spring and autumn, and it was noted that when in this condition they are often hidden in the ooze at the bottom of the dish.

Notes and Queries.

Sealing Glycerine Jelly Slides.—Mr. T. H. Russell, of Birmingham, writes in reference to a recent note in these columns on the above subject: "As I have mounted in this medium on and off for nearly thirty years, I venture to send you a few remarks which may possibly be of service. In the greater number of my slides I have used, as the sealing medium, picture copal varnish, thinned when necessary with benzine, and this I have found most serviceable, as it does not dry so hard as to render it brittle. When the cell is of any thickness I always now use Ward's 'Brown Cement,' which contains marine glue, I believe, but which is easier of application than marine glue pure and simple. My experience of this is comparatively recent, but a friend, who told me of it, has used it much longer, and has found it very good. I should say, however, from my own experience, that the chief point lies in the thorough cleaning of the slide before sealing, and where this has been duly attended to I have never had any trouble with my sealing material. After removing the superfluous jelly with a knife, and washing the slide in cold water, I always finish the process of cleaning by means of a cambric handkerchief moistened at the tongue, which is the most efficacious means of removing all traces of grease; the process must be continued until the reflection of the light on the slide shows that all smears have been removed. But the reason why glycerine jelly mounts so often go wrong arises, I think, from circumstances antecedent to the sealing, for I have found by experiment both that no pressure whatever must be applied to the cover-glass when placing it on the melted jelly and also that the slide should stand for at least two or three months in its rough state before any attempt is made to seal it. Also the slides, when sealed, should stand in a fairly equable temperature, and should not be exposed to anything approaching severe cold. They will then, I think, stand almost indefinitely, at least, I have moss slides put up in this way twenty-five years ago."

[*Communications and inquiries on Microscopical matters should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge. Correspondents are requested not to send specimens to be named.*]

XUM

The Face of the Sky for July.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 3.48 and sets at 8.18; on the 31st he rises at 4.22 and sets at 7.49. On the 5th at 4 p.m. the earth is at its greatest distance from the Sun, the solar parallax then reaching it minimum value of 8″·66.

Notwithstanding the declining solar activity, sun-spots and solar prominences are still fairly numerous.

There is an annular eclipse of the Sun on the 10th, but no part of the phenomena will be visible in this country, the favoured regions being Brazil and the South Atlantic.

The positions of the Sun's axis and equator, and the heliographic longitude of the centre of the disc, are shown in the following table:—

Date.	Axis inclined from N. point.	Centre of disc N. of Sun's Equator.	Heliographic Longitude of Centre of Disc.
June 30 ..	3° 25′W	2° 50′N	282° 20′
July 5 ..	1° 7′W	3° 23′N	216° 10′
,, 10 ..	1° 8′E	3° 54′N	149° 59′
,, 15 ..	3° 23′E	4° 23′N	83° 50′
,, 20 ..	5° 37′E	4° 52′N	17° 40′
,, 25 ..	7° 46′E	5° 17′N	311° 31′
,, 30 ..	9° 51′E	5° 41′N	245° 23′

THE MOON:—

Date.	Phases.	H. M.
July 2 ..	☾ Last Quarter	2 34 p.m.
,, 10 ..	● New Moon	3 17 p.m.
,, 18 ..	☽ First Quarter	1 12 p.m.
,, 25 ..	○ Full Moon	4 30 a.m.
,, 9 ..	Apogee	10 18 p.m.
,, 24 ..	Perigee	0 0 noon.

There will be a partial eclipse of the Moon on the 25th, at 3 a.m.; partly visible in this country.

The particulars are as follows:—

First contact with shadow .. .. $3^h\ 4^m$ a.m.
Middle of Eclipse .. .. .. $4^h\ 22^m$ a.m.
Last contact with shadow .. .. $5^h\ 41^m$ a.m
Magnitude of Eclipse (Moon's diameter = 1) 0·620.
Moon sets at Greenwich, partly eclipsed, $4^h\ 10^m$ a.m.

THE PLANETS.—Mercury (July 1, R.A. $8^h\ 23^m$; Dec. N. 18° 56′; July 31, R.A. $7^h\ 54^m$; Dec. N. 16° 25′) is an evening star in Cancer; during the first week of the month the planet sets about an hour after the Sun.

On the 25th, the planet is in inferior conjunction with the Sun, and hence during the latter part of the month is unobservable.

Venus (July 1, R.A. $5^h\ 9^m$; Dec. N. 22° 13′; July 31, R.A. $7^h\ 47^m$; Dec. N. 21° 43′) is a morning star in Gemini, rising about 2.30 a.m. throughout the month.

The planet may be observed shortly before sunrise, in the N.E. portion of the sky.

Mars (July 1, R.A. $19^h\ 7^m$; Dec. S. 27° 33′; July 31, R.A. $18^h\ 34^m$; Dec. S. 28° 54′) is in opposition to the Sun on the 6th; near this date the planet may be observed due South about midnight, shining as a bright reddish star, rather low down in the sky.

This opposition is a favourable one, as the planet is approaching perihelion, and the distance between the earth and the planet is nearly as small as it can be.

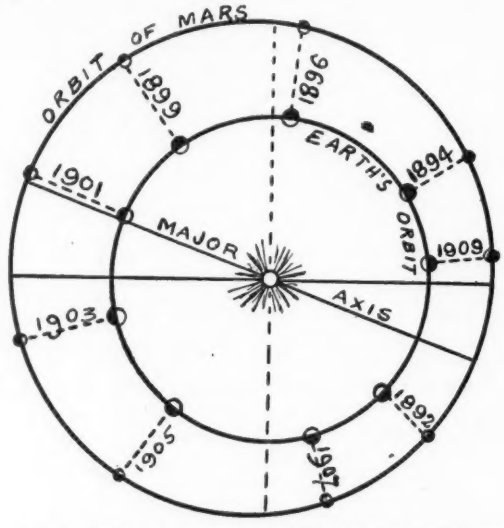
The distance of the planet from the earth at this opposition is about 38 million miles, compared with 35 million at the most favourable and 61 million miles at the most unfavourable opposition.

This diminished distance means increased brightness and apparent diameter, hence observations of the surface markings, which are always difficult in small telescopes, should be made about this time.

The apparent diameter of the planet is 22″·9, and the southern hemisphere is inclined towards the earth, thus bringing to our view the snow cap of the south polar regions.

The diagram below shows the orbit of Mars relative to that of the earth, with the positions of all the oppositions of the planet from 1892 to 1909. The opposition of 1909 will be slightly more favourable than this of 1907, in that the relative distances are 0·390 and 0·408, and the relative brightness 86 and 75.

On the 6th, the planet will be in conjunction with the star τ Sagittarii; the minimum apparent distance being only 9′.



Relative Orbits of Mars and the Earth showing Oppositions from 1892 to 1909.

Jupiter (July 15, R.A. $7^h\ 37^m$; Dec. N. 21° 50′) is in conjunction with the Sun on the 16th, and consequently is unobservable.

Saturn (July 1, R.A. $23^h\ 54^m$; Dec. S. 3° 2′; July 31, R.A. $23^h\ 53^m$; Dec. S. 3° 17′) is coming into a more favourable position for observation, rising at 10.35 p.m. on the 15th. The planet is situated in Pisces and is apparently stationary near the star 29 Piscium. Near the middle of the month the planet may be seen about midnight in the S.E. portion of the sky not very high above the horizon.

The elevation of the earth above the plane of ring is only 2° 20′, hence in the telescope the ring appears practically closed.

Uranus (July 15, R.A. $18^h\ 45^m$; Dec. S. 23° 26′) is in opposition to the Sun on the 3rd, hence about this date he appears due South at midnight. The planet is situated about ½° South of the star ν^2 Sagittarii, and although rather low down is otherwise well placed for observation. Its remarkable spectrum of broad dark bands is well worth the attention of observers, even though possessing only small instruments.

Neptune is not observable this month, being in conjunction with the Sun on the 5th.

METEOR SHOWER.—The most notable shower in July is that of the δ Aquarids, which occurs on the 28th. The radiant is situated in R.A. $22^h\ 36^m$, Dec. S. 11°, and the meteors are slow with long trails.